Everything's relative, or is it?

Abstract

The *special theory of relativity* has confused physicists for over a century, demolishing our intuitive understanding of time. Its success depends on two facts: 1) Einstein hid his *false premise* in the definition of *inertial reference frame* and then based all axioms on this, and 2) the *proofs* of time dilation, from *muon* to Hafele-Keating time differentials. Unlike quantum mechanics – with its Bohr, Bohm, Everett, and other interpretations – special relativity has only *one* interpretation: that of *space-time symmetry*. Herein I develop an *energy-time conjugation* interpretation offering a new way to interpret time dilation proofs.

A Century of Relativity

The philosophico-scientifico-political history of the twentieth century might be stated in two words: ***'everything's relative'***. Deconstruction in the literary universe and gender fluidity in the human universe would never have gotten off the ground if physics had not paved the way at the beginning of the century. Relativity and quantum mechanics are the bedrock of twentieth century physics and questioning either is not a prescription for a healthy career in physics. But there is one huge difference in these theories – whereas quantum mechanics has *multiple* interpretations (Bohr, Bohm, Everett, QBism, etc.), special relativity theory has only one interpretation – *space-time symmetry*. In this work I present an alternative interpretation: ***energy-time conjugation***.

As a result of relativity, twentieth century philosophy assumes the "relativity of simultaneity", which demolishes absolute time. Mankind has generally understood *absolute time* as *universal simultaneity* – it is *now* everywhere in the universe! If something is happening on Saturn at this moment, *right now!* – say a message is sent – it will take hours to reach us at the speed of light, so we won't know about it for *now plus a few hours*. This is *now*, as most people understand it. The key argument against simultaneity is the experimental "proof" of time dilation. The *energy-time theory* offers an alternate interpretation of this.

But since Einstein's 1905 paper, the cognoscenti believe that *simultaneity is relative*; relative to motion in 3-space, or position space. They envision *local time*, as told by *local clocks* that measure time perfectly. Einstein: every moving thing carries with it a position- and velocity-vector-based *inertial reference frame*. An *inertial frame* is a *map*, consisting of the representation of universal 3-space and universal time, attached to a specific moving object in our universe. Within the confines of the map, the origin of the 4-dimensional coordinate system, in time and space, is deemed *local rest*. All velocities in the context of this frame are relative to local zero. And Newton's laws of inertia operate in this frame, hence the name.

But the object itself is referenced to a *different* local zero, *our local rest frame*. Hence two frames.

In other words, *every* moving object carries its own universal time. But then problems arise – paradoxes, perhaps illusions. Does each body inhabit its own time, independently of all others? While we might expect any object moving in a specific inertial rest frame to know its own velocity, in its local environment, that is not the case. **Every inertial frame believes it is the center of the universe, and measures all other objects as if this were true**. This is sanctified by '*the law of the local speed of light*'.

It is well understood that the *relativity* of the twentieth century is rooted in Einstein's theory of special relativity. Another aspect of special relativity is not as well recognized: the *Geometricization* of physics. This too is a key aspect of the 'dematerialization' of the dynamic physical universe in favor of abstract transformations on static (for the most part) geometrical objects. The fact that geometry better character-

izes stable states than flowing dynamic transitions between states assures that the stable or static system will receive more attention. In the ultimate extreme, the *block* universe renders a dead geometric universe in which nothing ever happens, or can ever happen, and in which the present ('NOW') is not even defined. In short, the living, breathing, dynamic universe is reduced to static geometry. In general relativity the variation in energy density is replaced by 'distortion of geometry' (curvature). A recent text [40] begins:

> *"In this book, a central theme will be a Geometric Principle: the laws of physics must all be expressible as geometric relationships between geometric objects that represent physical entities."*

This clearly implies that Einstein's *inertial reference frames* are to be considered as physical entities! His general relativistic geometry of transformations between states of 4D coordinate systems is expressed as a *metric* linking coordinate events. Establishment physics prefers unphysical tensors instead of physics' most powerful mathematical tool: *geometric algebra*, which Hestenes introduced over half a century ago.

> *Physics tends to involve the projection of math "structure" onto physical reality, typically followed by the belief that physical reality <u>is</u> or <u>has</u> that structure. This belief obscures any real physical reality that is not so constrained.*

Although quantum field theory in *curved space-time* and general relativity in *curved space-time* ***both*** *represent "no gravity"*, gravity is the one ever-present force that needs no logical explanation; it is *de facto!* Yet it is banished and replaced by distortable coordinate geometries. The physical reality of *experience* is replaced by abstractions, signs and symbols; a problem Alan Watts often discussed.

The replacement of the *absolute* by the merely *relative* was not inconsequential – it broke the intuitive link that anchored us in metaphysical reality; the link that is the root of religious understanding. It is probably the diminishing of overly-traveled (trained) paths in physicist's minds and the personal reconnection to physical reality that accounts for a common reaction to an LSD experience:

> *'How could I have forgotten this?!'*

The reconnection is not a new insight so much as a forgotten mode of experience. Regardless of what could make one forget the root experience of reality – *absoluteness* – the theory of *special relativity* assures us that there is no *absolute* – no absolute time (universal simultaneity) or absolute space.

> *Relativity is in essence an attack on logic and an attack on experience, a banishment of the absolute from reality.*
>
> *One would not believe such to be possible had not one a century of proof before one.*

Initially (having accepted relativity for half a century) it seemed it would be simple enough to remedy, after all, special relativity is a simple theory, is it not? Yet this turns out to be misleading. The Lorentz transformation is simple, but its derivation and applications are complex, since they mix physical results with unphysical premises. The significance of *repetition* for learning is known: *if we hear something often we tend to believe it* – observe young people graduating with positive feelings for communism knowing nothing of the historical reality of communists murdering over 100 million people. Anyone paying attention to *mockingbird-like* repetition on all news channels observes the effect of repeated propaganda on the mind of the *not-paying attention* public. Yet, after three generations of repetition of the theory of special relativity – contradictions and all – most physicists do *not* believe that they've been programmed to believe a nonsense theory, based on key experiments that demonstrate "time dilation", defined and interpreted through Lorentz transformation between frames in relative motion. Possessing only one interpretational framework, that of Einstein's *space-time symmetry*, they believe that time-dilation "proves" special relativity, with all its built-in contradictions, and that, essentially it's our own fault:

> *"Our minds did not evolve to understand the very fast* [relativity] *or the very small* [quantum]*."*

The fact is, this tribally-supported belief is presented as follows: either you buy the full relativistic package or we label you a *kook* or a *crackpot* and banish you from the tribe [there goes your career]. As a result, almost all physicists pay homage to special relativity and punish any 'deniers'. *Generations of repetition induced very strong beliefs* and relativity is presented as a *take-it-or-leave-it* package.

The psychology is not simple: physicists who buy the whole package have difficulty even *reading* a critical analysis of special relativity theory. Almost any point being made in a critique may cause a physicist to compare the new perspective to a *related* topic and to immediately think

> *"aha – I know that's not true for the related topic, therefore I reject it here now."*

Now if I were personally present then I would say to you:

> "*Wait – you are correct that this new point contradicts your current understanding of the related point you bring up, but we will find a new way to interpret the related point that you will see is preferable, because it does not have the built-in contradictions of special relativity.*"

– I've done this often enough that I know it works. Unfortunately, as you study this paper alone, I am *not* here to respond to your objection and to advise you that a better explanation is forthcoming. Therefore an objecting physicist typically tells himself "*I know something that contradicts this, therefore I will ignore this.*" In this way the true believer locks out any alternate understanding – and is rewarded by the tribe for so doing – one is allowed to remain in the tribe.

I've experienced *knowledgeable* readers who constantly find contradiction with other aspects that are *known* to be true, and reject the new information based on their belief that relativity means *space-time symmetry*, *time dilation*, and *relativity of simultaneity*, as a package deal. Yet equally bright people – electronic engineers who have *not* been required to believe in all details and aspects of special relativity – are able to read the *energy-time critique* of *space-time symmetry* and actually learn a new interpretation. They do not have the well-traveled paths in their brain that many decades of relativity have worn down, nor do the engineers face the tribal threats that physicists face when questioning space-time symmetry. The engineers don't react emotionally, many physicists do.

There's nothing I can do about the psycho-dynamics of challenging belief systems except to point out that it is common and well understood. In short, the more you know about relativity and the more you've invested in coming to terms with the *paradoxes* [logical contradictions] of relativity, the more difficult time you can expect learning a new physically correct energy-time interpretation of relativistic dynamics.

Whatever group you find yourself in, I have tried to present the details, including equations, necessary to contrast the *entire space-time symmetry theory* with the new *energy-time conjugation theory*, to help you understand the new interpretation. To make this more accessible to the non-mathematically inclined, it is written in such manner that the equations can be ignored and their sense derived from the conversation.

The conversation occurs between Heinrich Hertz and Albert Einstein, both representing that extremely rare circumstance; both men were experimental *and* theoretical geniuses. Hertz demonstrated the existence of radio waves. Einstein [with deHaas] experimentally linked magnetism and angular momentum. These two extraordinary physicists tackled Maxwell's equations but diverged in their interpretations of reality, despite that Einstein based his classic paper on Hertz-Maxwell equations. The following offers insight into how these geniuses would react to another century's experience of physics.

Everything's Relative, or is it?

- A century of relativity
- A postmortem – Reality according to the Hertz-Maxwell equations
- Inertial reference frames

The Lorentz Transformation

- The Lorentz transformation
- The Lorentz factor derived in one inertial frame
- An erroneous derivation of Lorentz from radar

Lorentz Velocity Addition Law

- The Velocity Addition law
- The Relative Velocity of Two Bodies under the Addition Law
- The Doppler Effect for Fizeau's Experiment

The Physics of the Fizeau Experiment

- The Modern Theory of Light in a Moving Material
- The Physics of Water
- The Physical Basis of Fixed Time Delay
- The Modern Theory of Light in Bosonic Material
- Energy is Lorentz constrained, not relative velocity

Key Equations for Gravitational Ether

- Gravity as Local Ether
- The Maxwell-Hertz equations
- Faraday's field derivatives: the *convective derivative*
- Does *Noether's theorem* imply ether?
- The covariance of physics in all frames
- Perspectives on electromagnetic propagation

Physics versus Geometry of Relativity

- From physics to geometry
- The logic of cause and effect fails
- From geometry to physics
- *Space-time symmetry* versus *Energy-time conjugation*

Time Dilation of Inertial Clocks

- Apparent time dilation
- Perfect clocks
- The theory of inertial clocks
- The Global Positioning System (GPS) clocks

Key Experiments

- Ives-Stilwell *time dilation* experiment

The Detection of Absolute Motion

- The Relativity of Simultaneity and detection of absolute motion

A Post-mortem — reality according to the Hertz-Maxwell equations

The ghosts of Heinrich Hertz and Albert Einstein walk into a tavern. The tavern keeper, a hearty fellow, immediately recognizes them, leads them to a quiet corner, and serves complimentary beer. They observe the walls in their corner are covered with technical papers. On the wall behind Hertz is his 1890 paper [1]:

"On the fundamental equations of electromagnetics for bodies in motion",

while behind Einstein is his 1905 paper [2]:

"On the electrodynamics of moving bodies".

The tavern keeper explains. One of my regulars, Oliver Heaviside, frequently drops in to discuss physics. He analyzed gravito-magnetism in that 1893 paper [3] on the far wall. But Einstein, your $E = mc^2$ completely changes Heaviside's finding that the gravito-magnetic field is negligibly weak. The field interacts with mass, so, having energy, these fields have mass and hence nonlinearly interact with themselves.

AE: The nonlinearity of gravity is compatible with my later work. Did you wish to discuss Heaviside?

TK: No. I hope we can discuss the proposition that: *all light propagates in local gravity*. As Einstein begins to respond, a waitress approaches the table… The tavern keeper continues: Einstein, you are reputed to have once said, "*If you understand physics you should be able to explain it to a waitress.*" Here is our waitress, Rose Atkinson, who wishes to ask you a question. Rose, this is the famous Herr Doctor Einstein.

AE: Actually, I believe it was Rutherford who said as much, but I generally subscribe to the idea. Hello my dear, it's very nice to meet you. What is it you would like to know about physics?

Rose: Hallo Herr Professor. I am most honored to meet you. I have understood that you teach the "*relativity of simultaneity*", and that this is based upon different objects acting as if their times were different. Pray tell me what led you to believe time is different according to one's state of motion.

AE: You are very astute fraulein! Perhaps you have heard of experiments performed by Messrs. Michelson and Morley, in which they viewed the ether as flowing past the earth with velocity that relates to the motion of the earth in orbit about the sun. If light propagates through ether, then it is carried by the ether and its speed will differ depending upon whether it is propagating across the ether flow or with the ether flow. Do you know this?

Rose: Yes Herr Professor – it is like rowing a boat across the current or rowing upstream or downstream.

AE: Excellent, my dear! Yes, exactly. So Messrs. Michelson and Morley split a beam of light such that part of the beam travels across the river of ether while the other part traveled in the direction of the ether flow. Each part struck an appropriately placed mirror and then returned to the source. They were able to time the appearance of the reflected beams in such a manner that they would be able to calculate the velocity of the ether. Velocity is a term that combines speed and direction, for example the river may flow south at 10 km/h.

Rose: Yes, yes. I understand Herr Professor.

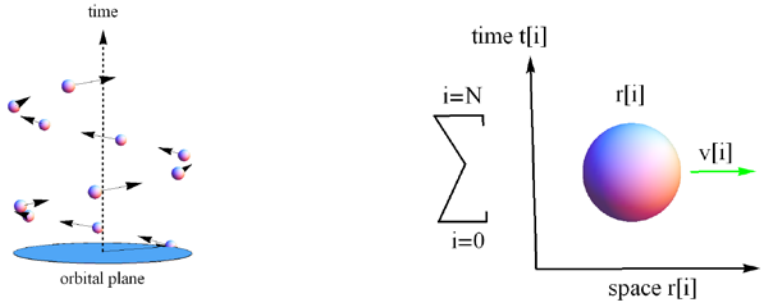
AE: Well my dear, very much to their surprise they found that the two light beams returned to the source at *exactly* the same time. Of course, this could happen if both beams were directed at 45° to the ether flow, but they then performed the same experiment at different times. Due to the rotation of the earth about its orbit and its motion about the sun, the directions of the light beams keep changing, so they cannot always be 45° with respect to the ether current.

Inertial Reference Frames

As MM measured zero travel-time difference in every experiment, as if the velocity *v* of the ether is always zero. As the velocity of the earth varies, we conclude that the ether has no effect and

the speed of light in each inertial frame is constant with respect to the inertial frame.

Rose: Thank you, Herr Professor. I do understand this. But why do the different inertial frames have different times? I overheard Herr Heaviside discuss this issue once. In fact, he drew this diagram on his napkin, which I have saved:



The MM experiment was performed at different places and times in the Earth's orbit. Einstein viewed this as an array of inertial frames [i], each with a 4D coordinate system attached to the laboratory, specifying a 3D space r[i] and 1D time t[i]. But Earth exists in and travels through *one* time dimension, not *one per location!*

He believed that for each experiment on Earth you represented the laboratory as having a time and position in space as shown by the formula on the right. The successive locations of earth in its orbit are shown at left. Mr. Heaviside suggested you viewed the universe as the sum of these frames:

AE: That is a nice representation of my analysis of the situation. You seem to have an amazing grasp of the situation my dear.

Rose: Oh thank you Herr Prof. I have the honor of serving many amazing gentlemen, and they speak of wondrous things. They think so clearly that even I sometimes feel that I understand the gist of their thinking. M. Heaviside pointed out that the classical conception of universal time has the earth moving through *one* time and three space dimensions. The mere fact that clocks or seasons 'tell time' along this dimension does not argue for multiple time dimensions, yet that is exactly what you postulated Professor Einstein. Of course when you create these multiple time dimensions, you fracture the classical understanding of absolute *time as universal simultaneity* and you then proclaim "*the relativity of simultaneity*". But this is where I am puzzled. I do understand the succession of locations and times associated with the earth in its orbit (where the experiments were performed) and I accept that the formula represents these different times and places, but why do times run differently for different experiments. If I walk three blocks to a fruit stand and drop an apple to the ground, the apple will fall exactly the same as if I drop it here, before I leave. Why do you assume that each experiment has its own time dimension? That seems in some ways similar to introducing the Tower of Babel into physics.

AE: Fascinating! I'm afraid that **this point rests upon a mathematical formulation that follows from the assumption that the speed of light is constant in all inertial frames**.

Rose: But do you not define inertial frames (as M. Heaviside informed me) as each having its own copy of time, and does not each copy run at its own rate? I have trouble understanding why time would run differently according to local circumstances.

The Lorentz Transformation

AE: Rose that is true according to intuition, but simply fails to be the case when one solves for equations that transform from one frame to another. The Lorentz transformation, which is the characteristic transformation of special relativity, *"connects the spatial and temporal coordinates of a point in one frame of reference with those in another frame of reference moving relative to it with a uniform velocity."* [34]

Rose: Oh my – I have new customers to attend to (three gentlemen had entered the Tavern). Thank you so kindly Herr Professor (as she leaves).

TK: I thank you ever so much, Professor Einstein. Rose is a very intelligent and diligent person and she worries about the 'relativity' of the modern view. But might I point out that she is correct in her point that you do *'build-in*' the time difference when you assign a copy of time to each inertial frame.

As the noise of new customers being seated across the room died down, Professor Hertz spoke up…

HH: Yes, Einstein, you derive the Lorentz transformation between two frames, but I believe the girl was asking why it is that you *have* two frames, each containing a time dimension. You have not answered that.

AE: Oh but my good fellow, two frames naturally lead to the *Lorentz transformation*, which is implied by Maxwell's equations; hence it is absolutely necessary to allow each inertial frame to have its own time.

HH: We shall come back to your point about the implications of Maxwell's equations, but why not solve the physics problems in one universal frame?

TK: It is true that textbooks [7,8,15,16,17,18,19,34] derive the Lorentz transformation between two inertial frames. For instance Freund [18] begins his derivation of the Lorentz transformation by stating that

> *"The quantitative treatment of problems in special relativity* ***necessitates two inertial reference frames****…"*

If so, it is significant that one can actually derive the Lorentz transformation in only *one inertial frame*. But then one wonders why it would be necessary to assume *two* frames *with* two different times?

AE: Of course the transformation is, generally speaking, between two 4-dimensional coordinate frames in relative motion. How does one then *obtain the Lorentz transformation in one inertial frame?*

HH: Einstein, let me get this straight. You claim that Maxwell's equations require Lorentz transformation in order for the equations to be formally covariant, having the same form in *any* inertial reference frame. You also claim that the Lorentz transformation must be derived in terms of two inertial reference frames. From these two claims you infer that the Maxwell requirement of Lorentz transformation implies the physical reality of two inertial frames, *each with its own time dimension*.

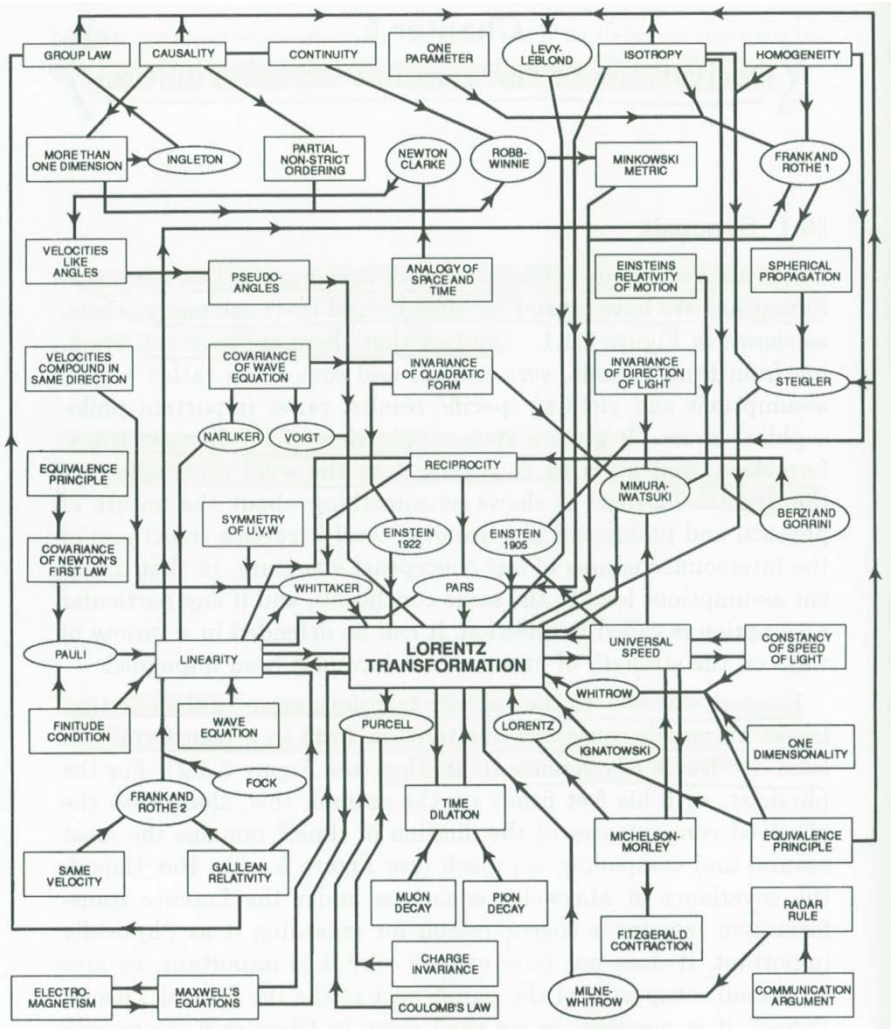
AE: That is the essence of my argument.

HH: Indeed. I believe that both claims are mistaken, and that your argument for two times evaporates.

AE: I would be most interested in hearing your argument.

HH: The tavern keeper first made the argument, so I will ask him to explain it.

TK: I would be most happy to do so. First let us consider the argument that, since all derivations involve two inertial frames, Maxwell's need for Lorentz implies two inertial frames must physically exist. Lucas and Hodgson [34] have reviewed the many derivations of the Lorentz transformation and summarized these in a most impressive diagram:



AE: Yes, that is most impressive. So please explain, bearing in mind that there is *no preferred frame*.

TK: But Prof Einstein, if we derive the Lorentz transformation in *only one inertial frame*, that frame is, by definition, the preferred frame. This comes from setting $t' = t$ in the Lorentz transformation.

AE: But Lorentz is <u>defined</u> as the transformation between *two inertial reference frames*. What, pray tell, are you transforming between?

TK: I transform between two *energy states* – the rest energy state corresponding to $\vec{v} = 0$, [*0* or mc^2] and the kinetic energy for $\vec{v} \neq 0$ [$mv^2/2$ or $\gamma mc^2 \cong mc^2 + mv^2/2$].

AE: But special relativity is <u>defined</u> in terms of two inertial frames!

TK: True. Special relativity is based on a *geometric* transformation. I am describing a theory based on *energy* transformation. All non-intuitive nonsense and paradoxes of special relativity are associated with geometric transformations in terms of *space-time symmetry*, following your requirement of *no preferred frame*. But the basis of these paradoxes lies in your gedanken experiments. Length contraction has never been experimentally measured. On the other hand, the need for the Lorentz energy transformation factor is confirmed by relativistic particle physics, as evident in most gauge theory formulations.

AE: But surely you acknowledge time dilation. It is today quite common, ranging from the muon to the *Global Positioning System* [GPS]. These have meaning only in terms of two time dimensions.

TK: I acknowledge your argument and the experimental basis for it. But let us take this one step at a time. We are explaining how Lorentz is derived in one inertial frame. Let us address 'time dilation' later.

AE: I cannot imagine how, but please proceed.

TK: The key parameters in special relativity are *velocities* – the speed of light in reference frames and the uniform relative velocity between frames. The formulation of the theory is not dependent on energy, despite that $E = \gamma mc^2$ falls out of the theory. In fact, the relation between Galilean and Lorentz transformation is an *energy factor* $\gamma\left(mv^2/mc^2\right)$. *We now derive the energy factor* by assuming that *our goal is to end up with the required Lorentz transform.*

The Lorentz factor derived in one inertial frame

TK: Proceeding on the basis of energy, the relation between an object at rest in an inertial frame and a moving object in that frame does not depend upon velocity but upon *energy*, related to velocity squared. But *space-time relativity* is based on velocity $\vec{v}$ and is independent of energy, mv^2. Key to *space-time symmetry* is your decision to transform the moving object into a *rest frame* in a second inertial system. From an *energy-time* perspective, the $v = 0$ aspect defines the *ground state* of kinetic energy in this inertial frame: $mv^2 = 0$. The energy difference of the two systems is $mv^2 - 0$. However your $E = mc^2$ sets a limit on this approach; if a particle's energy exceeds mc^2 a new particle can be created, significantly changing the physics that we started with. Particle colliders proved the need for the Lorentz factor for relativistic energies, so we limit our concern to particle energy mv^2 for $0 < v < c$, then $mv^2/mc^2 < 1$.

As Lorentz transformation describes a *length contraction* when one body moves with velocity $\vec{v}$ with respect to a body at rest, let us examine the classical measurement based on the Galilean transformation $x' = x \pm vt$. Measurement of length L using light produces *apparent* length contraction, $x'' = \alpha(v,c)L$.

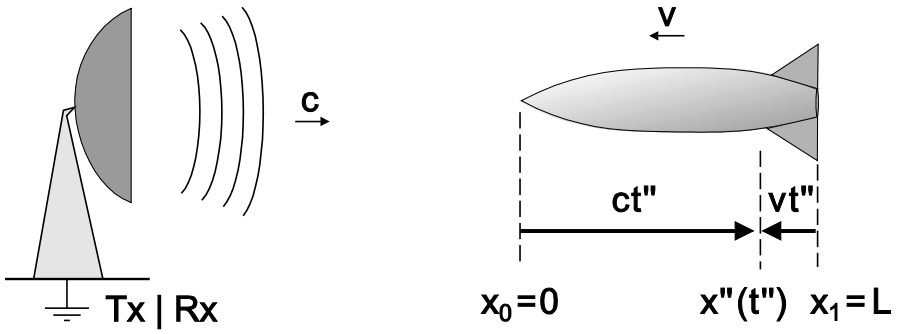


Fig 2. The emitted radar pulse strikes the nose of the rocket and reflects, yielding position x_0 at $t = 0$ after analysis. The rocket moves forward with velocity $\vec{v}$ while the pulse moves toward the tail fin at x_1. The radar pulse meets the tail at position x'' at time t'', such that $x'' < L$.

The $\alpha(v,c)$ represents the 'contraction' and we find $\alpha(+v) = \dfrac{1}{1+v/c}$ and $\alpha(-v) = \dfrac{1}{1-v/c}$

where + and − signs represent an object approaching or receding with velocity *v*. In the limit $v/c \to 0$ the Lorentz transformation reduces to Galilean. Dividing the Lorentz by the Galilean, we find ($v/c \neq 0$) the *energy-based factor*: Lorentz = energy factor × Galilean $\Rightarrow$ $g(x,v,v^2,c,t) = \gamma(mv^2/mc^2)\ f(x,v,t)$:

$$\gamma\left(mv^2/mc^2\right) = \frac{g(x,\dot{x},\dot{x}^2,c,t)}{f(x,\dot{x},t)} \qquad \gamma = \frac{x' = \gamma(x-vt)}{x' = x-vt}$$

The problem we address is this: Galilean covariance (translation and boost) forces non-unitary dynamics to produce *an infinite growth of the system's energy on long timescales*. Lorentz transformation *prevents* this impossible situation, via energy-dependent factor $\gamma(mv^2)$ derived from the Galilean transformation $f(x,v,t)$: $x' = x \pm vt$. Converting Galilean apparent contraction $\alpha(+v)$ to Lorentz $\xi(v,c)$ we define $\xi(v,c) = \beta(v^2,c)\,\alpha(+v)$ which must reduce to the identity function: $c \to \infty : \beta(v^2,c) = 1$. Finally, we make use of the fact that "*the inverse of a Lorentz transformation is another Lorentz transformation* $-\vec{v}$ *instead of* $+\vec{v}$." So $\xi^{-1}(v,c) = \beta(v^2,c)\,\alpha(-v)$. The inverse relationship implies

$$\xi\xi^{-1} = 1 = \beta^2\alpha(+v)\,\alpha(-v) \qquad \beta^2 = \left(1+\frac{v}{c}\right)\left(1-\frac{v}{c}\right) \Rightarrow \beta = \sqrt{1-\frac{v^2}{c^2}} = \gamma^{-1}$$

$$\xi = \beta\,\alpha(+v) = \frac{\sqrt{1-v^2/c^2}}{1+v/c}\left(\frac{1-v/c}{1-v/c}\right) \Rightarrow \frac{1}{\sqrt{1-v^2/c^2}}(1-v/c) = \gamma(1-v/c)$$

Thus $x' = \xi x \Rightarrow x' = \gamma(1-v/c)x$ but the stationary length $L = x = ct \Rightarrow x/c = t$ therefore:

$$x' = \xi x \Rightarrow \boxed{x' = \gamma(x-vt)} \qquad \textbf{the 3D+1 Lorentz transformation}$$

> *Unlike <u>all</u> special relativity derivations of Lorentz, which are based upon two inertial frames, our energy-based derivation occurs in* ***one*** *inertial frame, thus* ***only one time dimension is involved****. This disproves the argument that the Lorentz transformation <u>implies</u> two time frames:* $t' \neq t$.

The Galilean transformation using radar measurement yields *apparent* length contraction as the start of the measurement occurs when the radar pulse is reflected from the nose of the approaching rocket and the tail moves toward the wave front as the wave front moves toward the tail, thus reducing the length the wave front must travel before being reflected from the tail. If we instead considered the length of *one cycle* of the radar wave, the leading edge of a cycle would reflect at $t = 0$, while a finite time would be required for the trailing edge of the cycle to reach the rocket, during which time the rocket would be moving toward the trailing edge. This effective shortening of the cycle corresponds to contraction of the wavelength $\lambda \to \lambda - \Delta\lambda, \Rightarrow \nu \to \nu + \Delta\nu$ and the shift of wavelength is known as the *Doppler shift*. So radar measurements produce apparent length contractions and Doppler shifts <u>not</u> special relativistic length contraction. Should we reject [10] relativistic length contraction? *Yes!* As Rindler notes:

> *"No direct experimental verification of length contraction has yet been attempted."*

AE: If one is going to reject special relativistic length contraction why would one modify the Galilean formula to produce the Lorentz transformation based on the addition of an energy factor to the Galilean?

HH: Perhaps because it is the *energy factor* γ that is the difference between Galilean and Lorentzian. And also because it is the energy factor that actually is implied by 20th century physics.

An erroneous derivation of Lorentz from radar measurements

TK: To summarize, we intentionally set out to *derive an energy-factor* γ that relates the Galilean transformation to the Lorentz. In a conventional approach, Lucas and Hodgson claim that Whitrow and Milne

> *"…developed an elegant and thought-provoking derivation of the Lorentz transformation from the Radar Rule…"*

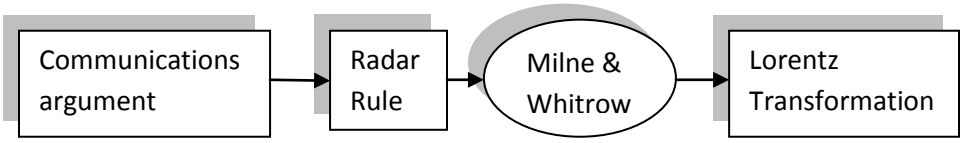
by invoking *two* measurements based on radars in relative motion with respect each other. They then invoke "*lines of simultaneity*" and proceed to draw tick marks on various lines, finally admitting that

> ***"The argument thus given is geometrical…"***

Yet *other assumptions* are required, including that electromagnetic radiation be received and *understood*, thus providing a means of *communication* between observers in different inertial reference frames! This is a *radical* new assumption. They claim that the *Radar Rule* is justified after expressing (x, y, z, t) and (x', y', z', t') as characterizing the inertial frames, and after assuming such *communications*, but do *"not assume that each thinks that the other's clock is telling the same time as his own one*." Moreover,

> "*the general form of the Radar Rule follows… based on additional premises about the nature of distances and distant events*" and on "*agreeing that dating systems are arbitrary.* $t' \neq t$ *We have taken this for granted in working with frames of reference."*

This Lorentz derivation, linked to their main diagram, begins at lower right and follows the arrows:



As always, by *defining* inertial reference frames as each having its own universal time, Einstein, you sneak an *unphysical assumption* into every argument formulated in terms of two such reference frames. The only way to avoid such meaningless argument is to derive the γ-factor in one inertial frame as we've done [12]. Nevertheless, while insisting on two inertial frames, Lucas and Hodgson do acknowledge that

> *"The communication argument* [for Radar = Lorentz] *gives us a derivation which is not a water-tight mathematical proof, but a schema of argument which has many holes in it…"*

Thus an excellent textbook written by a philosopher and a physicist [34] claims that a radar-based derivation yields the Lorentz transformation. But we have shown that the Doppler transformation results from radar-based measurements in one inertial frame; the difference between Galilean and Lorentz treatments takes the form of an *energy-factor*. Special relativity applies energy factor γ everywhere; to length *contraction, time dilation*, and to the *law of velocity addition*. But perhaps, in reality, γ applies only to energy, as expressed in the covariant energy equation $E = \gamma mc^2$.

The Velocity Addition law

AE: Surely you do not suggest that the law of velocity addition is to be discarded! In classical physics a vector sum of two velocities $\vec{u}$ and $\vec{v}$ is the velocity $\vec{w} = \vec{u} + \vec{v}$. The Lorentz velocity addition law is

$$w = \frac{v+u}{1+vu/c^2}.$$

TK: But it appears that energy aspects of Lorentz are physically relevant while velocity laws are not.

AE: Oh I must disagree strongly. Much of the basis underlying my 1905 work was Fizeau's 1851 experiment on Lorentz invariant velocity; I said (1920) in *Relativity: the Special and General Theory:*

> The Fizeau experiment "*decides in favor of [the velocity addition law] derived from the theory of relativity, and the agreement is, indeed, very exact."*

Indeed, Fizeau measured velocities to within 1% of that predicted by the law of addition of velocities, which is *implicit* in the Lorentz transformation.

The Relative Velocity of Two Bodies under the Addition Law

TK: While relativity is often defended on the basis of Fizeau's measurement of the speed of light in water, the water was flowing $\sim 30 m/s$, yielding $v/c \sim 10^{-7}$. There are <u>two</u> special cases that exist: for very low velocity $u, v << c \;\Rightarrow\; w \approx u + v$, while for very high velocity: $u, v \sim c \;\Rightarrow\; w \approx c$. In the *low velocity limit* the Lorentz law of velocity addition reduces to Galilean, as expected, while very high velocities on the order of the speed of light yield results that predictably cannot exceed the speed of light.

AE: Yes, I agree that Fizeau's experiment deals with very small effects: $v/c \sim 10^{-7}$. However, the law of velocity addition also makes prediction for high speeds, when $v/c \sim 1$. The Lorentz transformation says that the relative velocities between two objects can <u>never</u> exceed c. As Fock[38] observed:

> *"In pre-relativistic mechanics the relative velocity of two bodies was defined as the difference of their velocities. Let the velocities of two bodies, both measured in the same frame of reference, be $\vec{u}$ and $\vec{v}$ respectively. Then the velocity of the second body relative to the first used to be defined as $\vec{w} = \vec{u} - \vec{v}$. This definition is invariant with respect to Galilean transformations but not Lorentz transformations. Therefore it is not suitable in the Theory of Relativity and must be replaced by another. The fact that $\vec{w} = \vec{u} - \vec{v}$ has no physical meaning becomes evident (if) the velocities $\vec{u}$ and $\vec{v}$ have opposite directions and magnitude near to the speed of light, or equal to it. The 'velocity' $\vec{w}$ will have a magnitude near or equal to twice the speed of light, which is evidently absurd."*

TK: But Professor, there appear to be problems here also. In fact, Cannoni[36] observes

> *"Explicitly or tacitly, in high-energy physics literature it is an accepted fact that the relative velocity of two particles can be larger than the velocity of light. In reality this is a macroscopic violation of the principles of relativity."*

And Weinberg[39] uses $\vec{v}$ as the relative velocity to evaluate the flux in *the center of momentum frame*:

> *"however, in this frame $\vec{v}$ is not really a physical velocity ; (…) for extremely relativistic particles, it can take values as large as 2."*

So Weinberg says relative particle velocities can add up to 2c, while Fock calls it evidently absurd! But modern accelerators achieve relativistic velocities and energies and *contradict the velocity addition law*.

AE: That is definitely problematical, but let us return to Fizeau's experiment, upon which I based my special theory of relativity. Certainly you agree that his was a meaningful test of velocity addition law.

TK: Prof. Einstein, Fizeau attempted to test Fresnel's 'ether drag' theory, in which *a moving body drags the ether with it* and thus adds the speed of the moving body to the speed of light. His experiment compared light shining through water flowing in one direction with light through water flowing in the other direction. The expected *Fresnel phase shift* for the two beams of light is given by [25]

$$\Delta\phi = \frac{4\pi L v n^2}{\lambda c}\left(1-\frac{1}{n^2}\right). \qquad \textit{Fresnel phase shift}$$

As Fizeau's result was very close to this, you viewed this as basis for the special theory of relativity. However, two years after your 1905 relativity paper von Laue showed that *the Fresnel 'drag coefficient'* can actually be *derived from* the formula for addition of velocities when the speed of light in still water is $u = c/n$, where $n =$ index of refraction. If water flows with speed v (*and drags the ether with it*) then

$$v_{LAB} = \frac{u+v}{1+uv/c^2} = \frac{\frac{c}{n}+v}{1+\frac{v}{cn}} \quad \text{so the difference in speed} \quad v_{LAB} - \frac{c}{n} = v\left(1-\frac{1}{n^2}\right)$$

to first order in v/c. This yields the Fresnel '*ether dragging*' formula: $v_{LAB} = \frac{c}{n} + v\left(1-\frac{1}{n^2}\right)$

Fresnel's *ether drag* formula supports the velocity addition law and *seems* to support the Lorentz transformation, and von Laue actually *derived it* formally *from* the Lorentz law of velocity addition. Yet when the energy factor is derived in <u>one</u> inertial reference frame, with <u>one</u> absolute time, the Lorentz factor does *not* apply to velocity, but to energy.

AE: Well, pray tell, how do you explain the Fizeau experiment...

The Doppler Effect for Fizeau's Experiment

TK: It is useful to compare Fresnel's approach with a simple analysis based on our Doppler radar derivation. The phase of a wave changes 2π radians every wavelength, thus the phase change over distance x is $2\pi(x/\lambda)$. What is x for a moving material medium? Our radar problem showed that light moves an apparent distance $x = \alpha(v,c)L$ for a moving object of length L. Therefore apparent distance is $x = cL/(c+v)$ for light *against* the flow of water and $x = cL/(c-v)$ for light *with* the flow of water. Thus phase shifts are $\varphi_+ = \frac{2\pi cL}{\lambda(c+v)}$ and $\varphi_- = \frac{2\pi cL}{\lambda(c-v)}$, and the difference in phase $\Delta\varphi$ experienced by light flowing *with* and then *against* the water is:

$$\varphi_- - \varphi_+ = \frac{2\pi cL}{\lambda}\left(\frac{1}{c-v}-\frac{1}{c+v}\right) \quad \Rightarrow \quad \Delta\varphi = 4\pi\left(\frac{L}{\lambda}\right)\left(\frac{v}{c}\right)\left(\frac{1}{1-v^2/c^2}\right)$$

where the sign determines which way the interference fringes shift. Therefore, to first-order in v/c the predicted *Doppler phase shift* is $\Delta\varphi = \frac{4\pi Lv}{\lambda c}$.

AE: However this ignores the fact that while the radar Doppler effect was measured *outside of* the body (the rocket) the Fizeau experiment is based on light flowing *within* the body of water, hence the relevant velocity is not c but $u = c/n$. With u substituted for c in the above, the result becomes instead:

$$\Delta\varphi = \frac{4\pi Lvn}{\lambda c}. \qquad \textit{Naïve Doppler phase shift}$$

The Modern Theory of Light in a Moving Material

TK: You are entirely correct, Herr Professor, but I would label this result *the Naïve Doppler phase shift.* Due to the complexity involved in the various equations of erroneous theories, the confusion surrounding the Fizeau experiment is quite high. Early concepts of light propagating through flowing water were based on the idea that the flowing water '*dragged the ether*' and thus affected the velocity of light relative to the stationary observer, however, it is generally understood that moving water does not *'drag the ether'*; despite the historical confusion, it now appears that [25]

"A moving medium, by virtue of its motion, has no effect whatsoever on the velocity of light."

Although the term *medium* is often used interchangeably, the "*moving medium*" referred to here is the *water*, not the *ether*. Maxwell-Hertz's equations refer to the propagation of light in the *ether continuum* that fills the vacuum. When *moving water* is the *medium*, we treat H_2O molecules as discrete particles and consider light propagation through *many* such. Sound waves propagate in water via *collisions of discrete water molecules*, and have a characteristic speed of sound. Light does <u>not</u> propagate through water based on molecular collisions.

The Marinov (1974) and Kosowski (1978) theories assumed [25] that light propagates in a material medium *precisely the same as in free space*; however the light is *delayed* by the molecules in the material medium and this accounts for the apparent reduction in speed of light in a *molecular medium.*

A new <u>physical</u> picture of light in flowing water is evolving; the *'fixed time delay*' picture is as follows: Light is absorbed by a water molecule for time period Δt_0 and is then re-emitted and travels a distance defined as the '*mean free path*' L_0 before being absorbed by another water molecule and repeating the process. If we ignore the *width* of the water molecules, the number of such events is L/L_0 for a given length L of water. Normally light travels distance L in time $\Delta t_c = L/c$. If a time delay is associated with the material, then light instead travels L in time $\Delta t_u = L/u$ where the effective speed of light in the material is u. The time difference between *material* and *no material* is:

$$\Delta t_{uc} = \frac{L}{u} - \frac{L}{c} = L\left(\frac{1}{u} - \frac{1}{c}\right) \Rightarrow \frac{L}{c}(n-1)$$

where index of refraction n is a material-dependent parameter that characterizes u in relation to the constant speed of light as $u = c/n$ therefore the *fixed time delay* is a function of the amount of material encountered by the light and of the apparent speed u, and hence when $n = c/u$ is the index of refraction

of the medium we have the time difference between these two times given by the above formula. In the *fixed delay model* a photon is absorbed by (*'becomes attached to'*) a molecule for fixed time Δt_0 after which it re-radiates into free space with velocity *c*. It encounters the next molecule after traveling L_0, the mean free path in the water. The total time to travel through a length L of the medium is thus

$$\Delta t_u = \frac{L}{u} \quad = \quad \left(\frac{L}{L_0}\right)\left(\Delta t_0 + \frac{L_0}{c}\right) \qquad \text{where} \quad \Delta t_0 = L_0\,(n-1)/c\,.$$

This time difference needs to be explained physically. If most of the length of the material consists of (ether-filled) space in which light travels with velocity c, then Δt_0 is assumed to be the *delay associated with each molecule*. If L_0 is the *mean free path* for light *between* the molecules that absorb light for time Δt_0 then the time for the light to traverse distance L_0 is $\Delta t_1 = L_0/c$ and the *total time per molecule and transit* of L_0 is $\Delta t_{L0} = \Delta t_0 + \Delta t_1$; the total time for length L of material with index of refraction n is:

$$\Delta t_u = \frac{L}{L_0}\left(\Delta t_0 + \Delta t_1\right) \quad = \quad \frac{L}{c}(n-1) + \frac{L}{c} \quad = \quad \frac{L}{c/n} \quad = \quad \frac{L}{u}$$

in agreement with the generic model. From our radar model we found apparent length contraction

$$x = \alpha(v,c)L: \qquad \alpha(+v) = \frac{1}{1+v/c} \qquad \alpha(-v) = \frac{1}{1-v/c}$$

therefore the time for light to traverse the apparent length x is $\Delta t = x/c$ and

$$\Delta t^{+} = \frac{\alpha^{+}L}{c} \quad = \quad \left(\frac{L}{c}\right)\frac{1}{1+v/c} \quad = \quad \frac{L}{c+v}$$

$$\Delta t^{-} = \frac{\alpha^{-}L}{c} \quad = \quad \left(\frac{L}{c}\right)\frac{1}{1-v/c} \quad = \quad \frac{L}{c-v}$$

The formulae derived above for light moving in the stationary medium should be changed if the material is moving with velocity v, since light moves through distance L_0 with velocity $c \pm v$ and the associated time is $\Delta t_1^{\pm} = \frac{L_0}{c \pm v}$. The fixed delay of the molecule is unchanged, i.e., $\Delta t_0 = \frac{L_0}{c}(n-1)$ to first order in v/c. We use these values to define the total time delay in each direction and thus rewrite the respective time delays through the moving material as:

$$\Delta t^{+} = \frac{L}{L_0}\left(\Delta t_0 + \Delta t_1^{+}\right) \quad \Rightarrow \qquad \Delta t^{+} = \frac{L}{L_0}\left(\frac{L_0}{c}(n-1) + \frac{L_0}{c+v}\right)$$

$$\Delta t^{-} = \frac{L}{L_0}\left(\Delta t_0 + \Delta t_1^{-}\right) \quad \Rightarrow \qquad \Delta t^{-} = \frac{L}{L_0}\left(\frac{L_0}{c}(n-1) + \frac{L_0}{c-v}\right)$$

One of these represents the time delay for light flowing through water moving with velocity v in the direction of light and the other represents the time delay for light flowing through water moving with velocity v opposite to the light direction. This is the situation in the Fizeau experiment, so we find that the difference in times for light flowing through both paths is

$$\Delta t_\varphi = \Delta t^+ - \Delta t^- = \frac{L}{L_0}\left(\frac{L_0}{c}(n-1)+\frac{L_0}{c+v}\right) - \frac{L}{L_0}\left(\frac{L_0}{c}(n-1)+\frac{L_0}{c-v}\right) \quad \Rightarrow \quad L\left(\frac{1}{c+v}-\frac{1}{c-v}\right)$$

This represents the difference in Doppler effects. Thus for the *fixed time delay* model, we derive the time difference for the Fizeau experiment to first order in v/c to be

$$\Delta t_\varphi = \frac{2Lv}{c^2-v^2} = \frac{2Lv}{c^2}\left(\frac{1}{1-v^2/c^2}\right) \cong \frac{2Lv}{c^2}$$

But Fizeau does not measure time delay; instead he measures *phase shift*, which we have seen is given by $\Delta\varphi = 2\pi(x/\lambda)$ where x is the distance traversed by the light. In the simplistic approach we calculate distance x as *velocity* times *time*: $x = c\Delta t_\varphi$. Since time delay $\Delta t_\varphi = 2Lv/c^2$ then distance $x = 2Lv/c$ and the phase shift for this distance is $\Delta\varphi = 4\pi Lv/\lambda c$. The measurements of the relevant Doppler *fringe shift* based on a modern physical model of light flowing through water is phase shift $\Delta\phi/2\pi$:

$$FS = \frac{2Lv}{\lambda c} \qquad \textit{Doppler fringe shift}$$

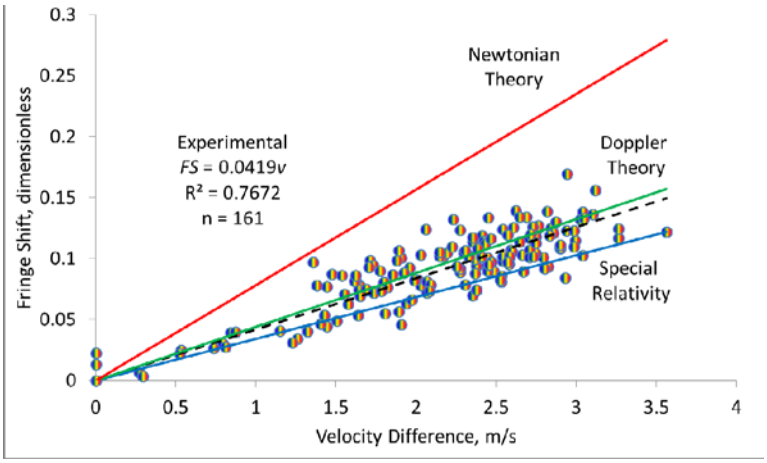
This Doppler fringe shift for the Fizeau experiment is to be compared to the Fresnel model above. And it is most interesting that the Fizeau experiment of 1851 was performed in 2013 by a Cornell University [35] team using *162-years-more-advanced-technology*. They fit their experimental phase [interference fringe] shift data to three theoretical lines defined by the formulae:

Newton theory: $FS = \dfrac{2Lvn^2}{\lambda c}$

Doppler theory: $FS = \dfrac{2Lv}{\lambda c}$

Special relativity:

$$FS = \frac{2Lvn^2}{\lambda c}\left(1-\frac{1}{n^2}\right)$$



The results most closely match the Doppler prediction we derived using radar. In fact, the *Doppler theory* is orders of magnitude better matched to the data than is the *Newtonian theory* or the *Special Theory of Relativity*. This is potentially very significant since the Fizeau experiment has been called [43]

"a crucial turning point between old and modern conceptions of light in space-time."

The above physical view is based on *all of the water-based-delay* occurring while the photon exists in a state equivalent to being absorbed by a molecule for time Δt_0. Ignoring the width of L/L_0 molecules means that *the entire length* L *of the water is effectively traversed at the speed of light* and the preferred apparent contraction is based on $\alpha(v,c)$ rather than the $\alpha(v,u)$ of the *naïve Doppler model*.

To make sense of these experimental results we analyze the key difference between the *Doppler theory* and the *Special Relativity* formula. Our treatment assumes a Doppler shift based on the velocity analysis used in our *radar measurement* model plus the *fixed time delay* model of the index of refraction, both of which are *physical phenomena*, yielding the Doppler phase shift formula $\Delta\varphi = 4\pi Lv/\lambda c$. The *Special Relativity* formula, on the other hand, can be derived based on *non-physical* "ether-dragging" model *or* based on the Lorentz transformation-based *law of velocity addition*, a *purely mathematical approach*. The Cornell experimental results shown above thus agree with *the prediction of the physical theory* and do not support *prediction of the mathematically derived formula*.

HH: Indeed, Einstein, if Lorentzian consequences are derived from ***unphysical premises***, such as the *constancy of the speed of light in all frames* and *multiple time dimensions*, why on Earth would one expect *physical predictions* to hold?

AE: But it is not the *speed* of light in water that is being measured; it is *the phase shift occurring over length* L that is being measured via shift of interference fringes; so your time delay model could conceivably imply a *random* phase shift of the photon upon its re-emission from each molecule. How can you assume that random phase shifts of re-emitted photons add up linearly?

The Physics of Water

TK: An excellent point: *What should we expect physically?* Amazingly, the fact is that while Fizeau designed and performed an experiment in 1851 based on measuring the flow of light through water, we're still, 168 years later, *unsure about the physics of water*. A recent issue of *Physical Review Letters* states [44]:

> ***"Liquid water … behavior is still not fully understood."***

One aspect in particular, the *long-distance correlation of liquid water molecules* is not understood, but …

> "*a nonlinear optical phenomenon involving the conversion of two photons at the fundamental frequency* ω *into one photon that the harmonic frequency* 2ω," such that "*scattered photons have well-defined phase differences*."

Thus there is *phase matching* between these photons. Since interference fringes are not single photon phenomena, we assume a statistically large number of photons flowing through the water at all times, and since photons are *bosons*, it is reasonable to assume *Einstein-Bose statistics* such that (the probability is high that) a molecule will emit a photon (laser-like) that is *in-phase* with the photon environment. If this is the case, then the phase of re-emitted photons is effectively neither random nor discontinuous.

So, Professor Einstein, if phase-matching occurs then we probably expect *non-random phase* behaviors to dominate statistically. And phase-modulation applied to 'shake' an optical-lattice-embedded atom [45] can transform the atom's momentum states:

> *"The wave function describing an ensemble of atoms in an optical lattice will evolve when the lattice is subjected to amplitude and/or phase modulation."*

Of course molecules in liquid water differ from atoms in an optical lattice, but existence of a correlation length (or equivalent), say L_0, is analogous to optical wavelength λ_0 and variation of this fundamental variable evolves the state of the system. The characteristic response of the system to a photon beam is expressed as the index of refraction with corresponding resonant state or wave function representation thereof. Therefore, if water molecules exhibit *long-range* interaction, it is perhaps not unreasonable to analogize H_2O molecules as being weakly bound to an optical lattice and the flow of bosons (photons) through the liquid might be viewed as amplitude and/or phase modulation seen by the molecules.

AE: Your phase-preservation argument, if true, does appear to grievously wound the velocity addition law, according to the modern Fizeau experiment, if valid. I wonder just what other surprises are in store.

The Physical Basis of Fixed Time Delay

TK: The demonstrated phase sensitivity of water molecules implies the possibility of synchronizing the relevant boson phase. If so, then *phase continuity* is in principle explained, but 'phase continuity' is different from 'time delay' and we need a *physical mechanism* to perform the *time delay* action; i.e., to couple the water molecules to photons responsible for the underlying behavior of *fixed time delay* model of light propagation through water. I believe this is explained by Ohta, et al.[46] in their first statement:

> *"In many physical systems, there are specific electronic states called 'dark states' that are protected from rapid radiative decay to conserve the system's angular momentum."*

Here *dark states* correspond to our *fixed time delay*, which is the state of the water molecule that has absorbed a photon and experienced a systemic change, but not yet radiated a consequent photon. I suggest that the corresponding *dark states* of water molecules are *protected from* rapid radiative decay to conserve the system's angular momentum.

Einstein, your experimental genius matched or exceeded your theoretical genius when you and deHaas in 1915 demonstrated that the electromagnetic B-field is coupled to the angular momentum at micro- and macro-levels. Angular momentum carried by the photon should be conserved throughout the process. The carrier of angular momentum for the photon is the magnetic field.

The photon's angular momentum is carried in the B-field so it is not unreasonable to assume that when this angular momentum is transferred to the molecule, it is through the electronic configuration of orbits of the electrons that interact with the incoming photon. The difference in *rest mass* of the photon and the electron and the difference in photon speed *c* and electron velocity *v* are such that the translation from energy $\hbar\omega$ propagated at speed c, to $mv^2/2$ at speed $\vec{v}$, appear to operate at different "time rates".

Angular momentum imparted by the photon is associated with the B-field and with characteristic speed c. When the photon is absorbed by an atom or molecule the angular momentum is then carried by the electron, characterized by velocity v. The angular momentum process relates to the non-zero rest mass of the electron and to the velocity $v << c$, for momentum mvr. So it's not surprising that the conversion of angular momentum from a photon to the relatively slowly changing electron charge configuration represents a delay compared to the speed of light traversing the width of the molecule.

The angular momentum of the photon is propagated with velocity c, based on the photon zero rest mass. When this angular momentum is transferred to the particle, atom or molecule, it propagates through the particles as $\vec{p}\cdot\vec{r} \sim mvr$ where $\vec{v}$ is the velocity of the electron and $\vec{r}$ is the radial arm. Thus we expect the angular momentum represented by the changing charged mass configuration characterized by velocity $\vec{v}$ to propagate far more slowly than for the photon moving at c. Angular momentum changes by $\pm h$ when a particle absorbs or emits a photon. Although in theory the excited state of the particle will decay

with random timing, it is likely that the decay is 'stimulated' by the photon environment, i.e., the other photons flowing through the water. When the phase of the environmental photons is such as to enhance the probability of admission, the molecule will transfer the angular momentum from the charged configuration back into an emitted photon. Physically, one expects that the absorbed photon initially disturbs *all* of the electrons (at least those in the outer shell) but this behavior is transient and all but one of these electrons return to their ground state such that the differential angular momentum is associated with one orbital electron. When the photon (boson) environment has the proper phase to enhance re-emission, a photon is emitted from this one electron. The absorption, transient response, and re-emission are characterized by the fixed time delay Δt_0.

Of course it is desirable to *quantitatively* calculate the expected delay for water molecules, but we set out to provide a *qualitative* understanding of the *fixed time delay* model of light flowing through water versus the almost two centuries old *ether dragging* model used to interpret the Fizeau experiment upon which Einstein placed so much credit for inspiring special relativity.

HH: Professor Einstein, it is rather interesting that both the Fizeau and Michelson-Morley experiments are used to justify special relativity, since there appears to be some inconsistency in these assumptions. The Fresnel *'ether drag coefficient'* assumes that *ether exists* and is dragged by the material through which light is flowing. But the Michelson-Morley experiment is taken to imply that *there is no ether*. Both are used as justification for special relativity, yet this contradiction is typically just glossed over in relativity. It is one of the many paradoxes that we should quit counting. One paradox is too much!

AE: *Hmmm (packing his pipe).* I am rather astonished. Fizeau's experiment and stellar aberration were the physical phenomena upon which I most strongly based my theory. *Lighting the pipe bowl of Mixture 79 he drew the smoke in … then blew a perfect smoke ring.* Of course the Cornell data could be wrong.

Rose: Am I correct to understand that the physics would seem to imply that the amount of time the light is "attached to" a molecule depends upon the specific molecule, and probably also on temperature and other thermodynamic variables.

TK: It indeed does appear to evoke *a thermo-dynamics of light in moving material*. This is likely the reason that the index of refraction is material dependent. Even more fascinating is that, generalizing the delay model by *super-cooling* the molecules so that they *'hold on to the light longer'*, effectively slows the speed of light even further; there are recent claims that light has been slowed to 30 mph!

The Modern Theory of Light in Bosonic Material

TK: In fact, Einstein, your own theory of *Einstein-Bose statistics*, given modern technology, has complicated this issue further. While *fermions* are particles that do not share the same quantum state, *bosons* are particles that can and do enter the same quantum state. In typical hyperbolic headline fashion, *Photonics Media* [42] announced that: *"Light changed to matter, then stopped and moved."* Of course the light did not "change to matter" – it was absorbed by ultra-cold molecules which changed their electronic configuration. This change propagates coherently through the coherent boson 'cloud' and is re-emitted. And apparently the cloud can be manipulated during the propagation to 're-shape' the light before it is re-emitted. Perhaps the best way to think of this is that, since bosons are particles that do occupy the same quantum state, *they lose their identity as individual particles* and act like a *super-atom* [with characteristics somewhat similar to a laser.] In a 1999 article [41] Lene Vestergaard Hau states:

> *"We demonstrate that we can stop a light pulse in the super-cooled sodium cloud, store the data contained within it, and totally extinguish it* [absorb it!], *only to reincarnate* [re-emit] *the pulse in another cloud two-tenths of a millimeter away. Such an exotic medium can be engineered to slow a light beam twenty million-fold from 186,297 miles per second to a pokey 38 miles an hour."*

Aside from calling the relativistic theory of light in moving materials into question, this slowing of light can make feasible an experiment to prove one of Einstein's basic principles of relativity wrong.

HH: Based on Einstein's (*hidden*) assumption of *multiple time dimensions* [impossible to demonstrate] – hence multiple 4D Minkowski geometries – one derives the Lorentz transformation *between frames* and the *'law of velocity addition'* follows. Does reality agree with this? Fizeau's experiment apparently does not. Relativistic particle physics does not, per Weinberg. Nor does the GPS system, as we shall see. The 'fixed delay'-theory yields the Doppler formula independently of relativity concepts. Rindler [7] also notes that the special relativistic treatment of velocities is problematical:

> *"Thus if a light signal recedes from me and I transfer myself to ever faster moving frames in pursuit of it, I shall not alter the velocity of that light signal relative to me by one iota. This is totally irreconcilable with our classic concepts of space and time."*

This is conceptually crazy, and it implies that the energy of the ever-faster object grows without bounds. Yet as soon as mv^2 exceeds mc^2 we can create new particles, and the nature of the problem changes. Thus one derives Lorentz in <u>one</u> inertial frame modulo mc^2: $mv^2/mc^2 < 1$. We could conclude that it is *energy* that is Lorentz constrained, it is <u>not</u> relative velocity.

Energy is Lorentz constrained, not relative velocity.

TK: In these cases a problem arises only if one believes that Lorentz applies to velocities – *it does not!* When Lorentz applies to energies; the equation that is preserved in transforming from one energy state to another is $E = \gamma mc^2$. So we reject the relativistic addition of velocities; only relativistic energy transformation and covariance apply: $E = \gamma mc^2$.

AE: The one-inertial-frame derivation of the Lorentz transformation is most interesting; however it says nothing of *time*, and we know from twentieth century physics that time dilation exists.

TK: But my dear Einstein, when Lorentz is derived in only one inertial frame, there is only <u>one</u> time, t. We will most assuredly return to the topic of time dilation, but may we first discuss '*gravity as ether*'?

Gravity as Local Ether

TK: Our initial proposition was: *all light propagates in local gravity*. Photons have energy, hence mass equivalence, and bend in gravitational fields, effectively refracting the light. *Light propagating in local gravity* constitutes a preferred reference frame, contrary to your conclusions, Herr Professor.

HH: Why that is most interesting! You clearly state, Einstein, that there is no preferred frame. You say: "*the same laws of electrodynamics and optics will be valid for all frames of reference*." But light propagating in local gravity *defines* the preferred frame in which the speed of light is constant. Frames moving with velocity $\vec{v}$ in a local gravity field will see a displaced speed of light, $c \pm v$.

AE: Quite so. My basic premise is the essential symmetry between all space-time frames; the *lesson of Copernicus*, one might say. But light propagating in local gravity would seem to break this symmetry.

HH: You also state that "*unsuccessful attempts to discover any motion of the earth relatively to the "light medium" suggest … no properties corresponding to the idea of absolute rest*." If not 'absolute' rest, *local gravity as ether* implies at least *local* or *relative rest*. That is a preferred frame, is it not?

AE: Why yes it is. *Any local preference would demolish the symmetry between all space-time frames*. That symmetry is the source of much confusion in special relativity. What picture do you have in mind?

HH: My dear Einstein, when bodies act upon one another at a distance, we can form various conceptions of the nature of this action. We may regard it as direct action-at-a-distance, springing across space, or we may regard it as the consequence of action which is propagated from point to point *in a local medium*. So *"the interior of all bodies, including the free ether, can experience disturbances* [that produce changes of state.] *These changes of state necessitate an expenditure of energy; their presence represents a stock of energy*."

TK: And if one views stress as a disturbance propagating through ether, we should also note [14]:

> *"At each point in a continuous media, whether it be solid or fluid, we need six numbers, each representing a component of force per unit area, to define the local stress completely."*

This *is* consistent with Hertz's 3 electric 'forces' $\vec{E} = (X, Y, Z)$ and 3 magnetic forces $\vec{B} = (L, M, N)$.

HH: True. In my paper, the energy density of the stressed ether is $(\varepsilon \vec{E} \cdot \vec{E} + \mu \vec{B} \cdot \vec{B})/8\pi$.

AE: But '*stressed ether'* seems to imply a velocity of ether flow relative to the earth's frame, not seen.

TK: Yes. But if local gravity *is* the medium of propagation, and the equipment is never moved from the lab, then the velocity of the lab frame with respect to this local ether is always $\vec{v} = 0$, compatible with all results! So they did not *disprove* local ether; only that a universal isotropic homogeneous ether is invalid. For this reason we perceive the Heaviside-Hertz ***electro-*** and ***gravito-magnetic*** equations to be:

$$\begin{aligned}
&\vec{\nabla}\cdot\vec{B} = 0 \quad (\vec{B} = \vec{\nabla}\times\vec{A}) && \vec{\nabla}\cdot\vec{C} = 0 \quad (\vec{C} = \vec{\nabla}\times\vec{v}) \\
&\vec{\nabla}\times\vec{B} = \mu_0\rho_q\vec{v} + \frac{1}{c}\left(\frac{\partial\vec{E}}{\partial t} + \vec{v}\cdot\vec{\nabla}\vec{E}\right) && \vec{\nabla}\times\vec{C} = -\frac{4\pi g}{c^2}\rho_m\vec{v} + \frac{1}{c^2}\left(\frac{\partial\vec{G}}{\partial t} + \vec{v}\cdot\vec{\nabla}\vec{G}\right) \\
&\vec{\nabla}\cdot\vec{E} = \rho_q/\varepsilon_0 && \vec{\nabla}\cdot\vec{G} = -4\pi g\,\rho_m \\
&\vec{\nabla}\times\vec{E} = -\left(\frac{\partial}{\partial t} + \vec{v}\cdot\vec{\nabla}\right)\vec{B} && \vec{\nabla}\times\vec{G} = 0 \quad \overset{?}{or} \quad -\left(\frac{\partial}{\partial t} + \vec{v}\cdot\vec{\nabla}\right)\vec{C}
\end{aligned} \tag{1}$$

The formal correspondence [5] between these equations allows substitution of mass for charge, and of Newton's gravitational constant g for ε_0 and μ_0 in Maxwell's relation $c = 1/\sqrt{\varepsilon_0 \mu_0}$ yielding:

$$c = \frac{1}{\sqrt{\varepsilon_0 \mu_0}} \quad \Rightarrow \quad [\varepsilon(g)\,\mu(g)]^{-1/2} \quad = \quad \left[\left(\frac{-1}{4\pi g}\right)_{\varepsilon}\left(\frac{-4\pi g}{c^2}\right)_{\mu}\right]^{-1/2} \quad = \quad \left(c^{-2}\right)^{-1/2} = c \qquad (2)$$

This might appear a tautology, but $\vec{E}, \vec{B}, \vec{G}, \vec{C}$ fields are *real* phenomena and ε_0, μ_0, and g are *real* physical parameters. If mass density ρ_m is exchanged for charge density ρ_q, and field correspondences applied, we find complete equivalence of these formal field equations, so deriving the speed of light from the gravito-magnetic equivalent of $c = 1/\sqrt{\varepsilon_0 \mu_0}$ *is* significant. Only months ago colliding neutron stars [6] were seen, *in both light and gravity waves*, showing that gravity *and* light propagate at c so $g = f(\varepsilon\mu)$.

"Einstein's axioms logically eliminated the ether concept in physics." [7]

If light propagates in gravity, the ether concept has <u>not</u> been eliminated from physics, conflicting with axioms that claim to eliminate the ether. Physicists can project mathematical structure onto reality and can come to believe that the corresponding physical structure <u>is</u> reality, as summarized [7] by Rindler:

"Each inertial frame now has the properties with which the ether frame had been credited."

The hypothesis of the constant speed of light 'tied to' each inertial frame is non-intuitive, yet supports the conception of multiple inertial coordinate frames as *real* space-time entities. But as Maudlin [8] observes:

"*…even if we can describe a mathematical structure that everywhere looks locally like a possible spacetime structure, it does not follow that the whole object corresponds to a physical possibility*."

HH: Einstein, you have never justified the creation of multiple 'real worlds' by adding 4D-coordinates to objects moving in the *unprimed* 4D-coordinate system of the real world. As Rindler notes:

"An inertial frame is one in which spatial relations, as determined by rigid scales at rest in the frame, are Euclidian ***and in which there exists a universal time****…*[such that Newton's laws of inertia hold.]"

Yet there is no direct proof of the existence of multiple 'universal times', each attached to a moving object or object at rest. You state that the Maxwell-Hertz equations hold in the moving frame and the rest frame for time dimension τ and t respectively and that all permutations *must express exactly the same thing:*

$$\frac{1}{c}\frac{\partial E_x}{\partial t} = \frac{\partial B_y}{\partial z} - \frac{\partial B_z}{\partial y} \quad \Leftrightarrow \quad \frac{1}{c}\frac{\partial E'_x}{\partial \tau} = \frac{\partial B'_y}{\partial \eta} - \frac{\partial B'_z}{\partial \xi} \qquad (3)$$

but there is no proof that $\partial E'_x / \partial \tau$ even has physical meaning. The τ is a time dimension that you only *postulate* to exist. If it does not physically exist, then this relation is a mathematical equivalence only!

AE: Oh, but my dear fellow, you ignore the numerous proofs of time dilation!

As if on cue, several things happened. Rose approached the table with fresh roses which announced their presence with sweet aroma; lightning struck the railway through town; a crash of thunder rattles the windows of the tavern; the clock on the wall struck 10 o'clock; and a distant railway train blew a long blast on its steam whistle to signal its approach to town. The *Tavern Keeper* smiled at the Doppler shift in frequency of the train whistle, thinking that every villager enjoyed and extracted information from the Doppler whistle, most of them with no knowledge of the mathematical models imposed on reality.

The Maxwell-Hertz Equations

TK: That train reminds me that Voigt in 1887 predicted the Michelson-Morley null results without prior knowledge of the experiment… he set himself the project of finding the Doppler effect that would make a wave solution to *Maxwell's equations have the same form for both a stationary observer as for a moving observer*, just as you have done above. His was based on elastic waves in the ether [25], yours on two 'universal times'.

HH: And I shall be happy to return to time dilation Prof Einstein, but your paper says that one need not "*assign a velocity-vector to a point of empty space in which electromagnetic processes take place*". That contradicts my assumption that "*at every point a single definite velocity can be assigned to the medium which fills space*." Einstein, your theory is based on my Maxwell-Hertz equations:

$$\frac{1}{c}\frac{\partial E_x}{\partial t}=\frac{\partial B_z}{\partial y}-\frac{\partial B_y}{\partial z} \quad \text{and} \quad \frac{1}{c}\frac{\partial B_x}{\partial t}=\frac{\partial E_z}{\partial y}-\frac{\partial E_y}{\partial z} \quad \text{and permutations,} \tag{4}$$

yet these equations are from my *first* paper developing the theory of electromagnetics for *bodies at rest*.

AE: Why, that is true! Which equations would you prefer that I use, Professor Hertz?

HH: Why my dear fellow, I would prefer that you use equations [24] from my paper [1] on *bodies in motion*:

$$\frac{1}{c}\left[\frac{d\vec{B}}{dt}+(\vec{v}\cdot\vec{\nabla})\vec{B}\right]=-\vec{\nabla}\times\vec{E} \quad \text{and} \quad \frac{1}{c}\left[\frac{d\vec{E}}{dt}+(\vec{v}\cdot\vec{\nabla})\vec{E}\right]=-\vec{\nabla}\times\vec{B}+\frac{4\pi}{c}\rho\vec{v}\,. \tag{5}$$

AE: Well I ignored those equations because I interpreted velocity $\vec{v}$ to be the velocity of the ether flow relative to the inertial frame. Nevertheless the truly crucial point is that Maxwell's equations are *not* invariant under Galilean transformation, and therefore require the Lorentz transform that I derive herein.

HH: Oh but that point is mistaken! Maxwell-Hertz equations are invariant under Galilean transformation;

$$\text{from } \vec{r}'=\vec{r}-\vec{v}t \text{ and } t'=t \text{ we find:} \quad \vec{\nabla}'=\vec{\nabla}\,, \quad \frac{d}{dt'}=\frac{\partial}{\partial t}+\vec{v}\cdot\vec{\nabla} \tag{6}$$

where $\vec{r}',t'$ and $\vec{r},t$ specify coordinates of the same point in two relatively-moving "inertial" frames.

The total time derivative is $\frac{d}{dt}=\frac{\partial}{\partial t}+\vec{v}_e\cdot\vec{\nabla}$ so applying Galilean law $\vec{v}_e'=\vec{v}_e-\vec{v}$ where $\vec{v}_e$ is *ether velocity* measured in the unprimed (rest) frame, $\vec{v}_e'$ is the same measured in the primed frame, and $\vec{v}$ is the (constant) velocity of the primed relative to the unprimed $(v=0)$ frame, we find [9]

$$\left(\frac{d}{dt}\right)'=\left(\frac{\partial}{\partial t}+\vec{v}_e\cdot\vec{\nabla}\right)'=\frac{\partial}{\partial t'}+\vec{v}_e'\cdot\vec{\nabla}' \quad =\left(\frac{\partial}{\partial t}+\vec{v}\cdot\vec{\nabla}\right)+(\vec{v}_e-\vec{v})\cdot\vec{\nabla}=\frac{\partial}{\partial t}+\vec{v}_e\cdot\vec{\nabla}=\frac{d}{dt} \tag{7}$$

which verifies the first-order Galilean invariance of $\frac{d}{dt}$. QED

AE: My dear Prof. Hertz, I never realized that your equations of electrodynamics *are* Galilean invariant. I simply *assumed* that velocity $\vec{v}$ was identically zero due to the lack of ether.

HH: There are two issues here. Equations are derived from Faraday, whose experiments involve wires that change shape while moving in a magnetic field. Thus the partial derivative is *not* sufficient and the total time derivative is required. Also, my equations assume a medium in which electromagnetic waves are propagated. If this medium is in 'relative' motion with respect to a frame, the waves are effectively *conveyed* and this is appropriately described by the convective derivative.

Faraday's field derivative: the convective derivative textbooks

TK: If I may interject. Mr. Phipps [9] has studied the electromagnetic field theory texts of the twentieth century and has reported that the major authors have all acknowledged the problem. He discusses Hertz's version of Maxwell's equations, wherein the *total time derivative replaces the partial time derivative*, in terms of classic E&M treatments. For example **Panofsky** and **Phillips**: [27]

$$\oint \vec{E}\cdot d\vec{l} = -\frac{d}{dt}\iint \vec{B}\cdot d\vec{S} = -\iint \frac{\partial \vec{B}}{\partial t}\cdot d\vec{S}\,.$$

The change from $\frac{\partial}{\partial t}$ to $\frac{d}{dt} \rightarrow \frac{\partial}{\partial t} + \vec{v}_d \cdot \vec{\nabla}$ is implied by the fact that *Faraday actually changed the shape of circuits*, altering the $d\vec{l}$ in flux-penetrated space. And **John David Jackson** [28] notes:

> *"Faraday's law can be put in differential form by use of Stokes theorem, provided the circuit is held fixed in the chosen reference frame…",* but *this contrasts with what Faraday actually did.*

Lorraine and Corson [29] allow non-inertial motions but require the circuit at all times to move as a rigid whole, *again conflicting with Faraday*. **Wangness** [30] claims to allow shape changes of the Faraday circuit, but Phipps criticizes this. **Ohanian** [31] inverts Panofsky and Phillips by taking the integrated form of Maxwell's equation as the starting point; $\partial\vec{B}/\partial t$ appears under the integral sign, *then he extracts the partial time derivative as a total time derivative*. **Smythe** [32] is also criticized, and **Purcell** [33] describes Faraday's observations by $\vec{\nabla}\times\vec{E} = -(1/c)\,d\vec{B}/dt$ but then he says *"Recognizing that* $\vec{B}$ *may depend on position as well as time we shall write* $\partial\vec{B}/\partial t$ *in place of* $d\vec{B}/dt$. *We have then these two entirely equivalent statements of the law of induction."* [true only if $v = 0$.] All of the texts recognize that**:**

> **Maxwell's $\partial/\partial t$ is a departure from Faraday's fundamental d/dt.**

AE: My word! I hope we can discuss time dilation soon.

HH: We can. But your time dilation and length contraction results are derived, as you say [2], "*with the help of certain imaginary physical experiments*". Yet, after more than a century [10], *no physical proof exists of length contraction*. And with respect to your popular railway gedanken experiments you state [11]

> *"The laws of transmission of light in vacuo must be the same for the railway car as reference-body as when the rails are the body of reference."*

Surely from the perspective of *'local gravity as preferred frame'* this is a false statement. Else the railway car must need to generate a local gravitational field greater than the earth's field associated with *the rails*.

AE: Oh, yes! If the hypothesis of gravity as local medium of propagation is correct, then my statement is assuredly incorrect.

Does Noether's theorem imply ether?

TK: I see that Rose is available to rejoin our conversation, and it is appropriate here to bring up a point about which Rose becomes excited, which is Emmy Noether's theorem.

Rose: Oh yes! And I'm overjoyed that Herr Professor Einstein has said of Emmy Noether:

> *"In the judgment of the most competent living mathematicians Fraulein Noether was the most significant and creative mathematical genius thus far produced since the higher education of women began."*

TK: Indeed. In fact [37]

> "*Noether's theorem forms a central organizing principle for all of physics*."

Noether's theorem for time translation uses Lagrangian $L = T - V$ [T = kinetic, V = potential-energy]:

$$\frac{dL}{dt} = \frac{\partial L}{\partial t} + \sum_{\alpha}\left[\frac{\partial L}{\partial q_\alpha}\dot{q}_\alpha + \frac{\partial L}{\partial \dot{q}_\alpha}\ddot{q}_\alpha\right] \tag{10}$$

If the generalized coordinate $q_\alpha = x_\alpha$ and $\ddot{q}_\alpha = 0$ then $\sum_\alpha \dot{x}_\alpha = \vec{v}$ and $\sum_\alpha \frac{\partial}{\partial x_\alpha} = \vec{\nabla}$, such that

Noether's theorem yields the operator expression acting on the Lagrangian energy balance:

$$\left[\frac{d}{dt} = \frac{\partial}{\partial t} + \vec{v}\cdot\vec{\nabla}\right]L \qquad \textit{this is the } \textbf{\textit{definition}} \textit{ of the convective derivative!} \tag{11}$$

Thus Noether's fundamental physics derived in 1918 was already 'built into' Hertz's electrodynamics of moving bodies in 1890. It is the key to Galilean invariance (where $t' = t \equiv$ universal simultaneity). It is of particular interest that an excellent book, [37] dedicated to Noether's theorem and relating *symmetry* to *conservation* as a main theme, never once, including an appendix on special relativity, mentions "space-time symmetry", which is the central point of Einstein's relativity, from which the relativity of simultaneity derives.

We know that $d/dt \sim \partial/\partial t$ are essentially energy operators, but what is $\vec{v}\cdot\vec{\nabla}$? In quantum mechanics $\vec{\nabla}$ is proportional to the momentum operator $\hat{p}$, hence we would surmise:

$$\vec{v}\cdot\vec{\nabla} \;\sim\; \vec{v}\cdot\vec{p} \;=\; \vec{v}\cdot m\vec{v} \;=\; mv^2 \;=\; energy\,. \tag{12}$$

That is, the convective *derivative represents an energy term associated with the ether velocity* that is tightly bound to *change with respect to time. It should show up in a Hamiltonian.*

The Covariance of equations in all frames

TK: The Lorentz factor, derived in *one inertial reference frame*, transforms the *energy* of a body between two states: an initial rest state ($v = 0$) and a final state of motion ($v \neq 0$). The expression describing energy for any state of motion is $E = \gamma mc^2$. This law of nature has the same form in every state of motion relative to the rest state, $v = 0$. *It is the relativistic energy equation of the 20th century.*

In the ***General Theory of Relativity***, space and time are not always isotropic; nonlinear transformations are permissible when gravitational fields are present. The *space-time Lorentz* does not apply in general.

In ***Quantum Mechanics*** the Lorentz transformation is also problematical. Consider *Bell's theorem*: two spin one-half particles, bound together in the singlet state (spin zero), are assumed to separate and travel a long way from each other, with the total spin assumed to be zero. Quantum mechanics stipulates that if the measurement of one particle's spin in a given direction yields $+1/2$, then the measurement of spin projection of the other particle in the same direction is $-1/2$. The Copenhagen interpretation is that two particles constitute a single entity (*the singlet state*) until one of the particles is measured, at which time the wave function 'collapses' and the anti-correlated state of both particles is determined, regardless of the separation distance between the particles! This "*non-locality*" simply cannot be formulated in terms of "*the relativity of simultaneity*", so the Lorentz transformation is not compatible with quantum mechanics.

Thus the space-time Lorentz transformation and its implied *relativity of simultaneity* is incompatible with *Classical Mechanics*, with *General Relativity*, and with *Quantum Mechanics*, but is claimed to be needed for Maxwell's electromagnetism; Einstein derived the Lorentz transformation in order to preserve Maxwell's equations across all frames. But he referenced the *Maxwell-Hertz equations*, which are Galilean invariant and do not require the Lorentz transformation. Thus *the Galilean transformation* is suitable for

- *Classical Mechanics*
- *Maxwell-Hertz's electrodynamics*
- *General Relativity*
- *Quantum Mechanics*

In fact, the *only* place the Lorentz factor *is* required is transforming from one energy state to another.

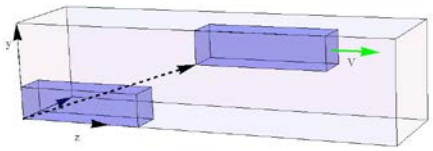
HH: Einstein, your model is easy to visualize. You thought (when formulating special relativity) that objects "float around in empty space"; that there is no universal medium as the ether was envisioned to be; there's only *the object in space*. Experiments designed to measure the speed of light relative to the object found *c*. To represent the object as "in the real world", you give it Newton's laws of inertia, and associate a universal time with the object, and *perfect clocks*. You then enforce regularity – by insisting that the laws of physics in one reference frame are preserved in form under a transformation from one frame (the rest frame) to another frame in relative motion with respect to the rest frame. It seemed a fact that every object measured the speed of light to be *c* with respect to the object, so you made it a postulate, thus creating a formal geometrical structure subject to transformation groups. Relativistic *space-time* theory is non-intuitive and non-sensible, while the '*Twins paradox'*, the '*both clocks run slower'* paradox, and the '*40 foot pole in a 20 foot garage'* are paradoxical consequences of *space-time symmetry*.

Finally, Einstein, may I contrast the physics from my paper [*on which you base yours*] with your own?

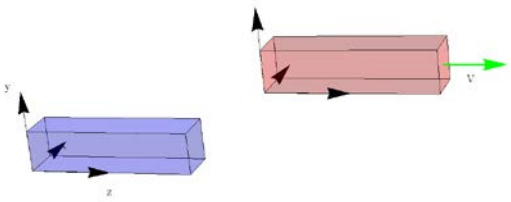
AE: Yes, please do.

Perspectives on Electromagnetic Propagation

HH: I view the reality of fields as energy **in** moving bodies, including the ether, while your description is **between** bodies in relative motion. Specifically, I view Faraday's *lines of force* as being conveyed by the ether, consistent with the "convective derivative". The *lines of force* simply represent a symbol for the special conditions of matter, that is, *local stresses in the ether* (which flow with the ether.) This conflicts with your principle that the speed of light is constant in all frames regardless of the speed of the emitter. At right, local ether is represented by *one* frame containing *both* physical entities, including simply disturbances in the ether. The entity at the origin is at rest with respect to local gravity, while the entity at upper right is moving with respect to local gravity.



In an ether-free perspective, you, of necessity, attribute physical properties of the ether to *each* inertial frame, two of which are shown here. And your astonishing contention that *each frame possesses its own time dimension* and *physical laws* essentially creates a *real world* each time you define a new inertial frame. This exemplifies the problem of identifying a mathematical projection as real physical structure, yielding paradoxes and contradictions associated with special relativity theory, for instance…



> *'Your clock runs more slowly than mine,*
> *while my clock runs more slowly than yours.'*

And yet your proposed length contraction has never been experimentally seen [10] or known to happen.

AE: Perhaps, but time dilation possesses much experimental support. For example, consider the muon.

HH: Well, something has experimental support! The question is perhaps one of *interpretation*. Einstein, your gedanken experiments always postulate two time dimensions, and draw conclusions about the behavior of clocks, assuming *perfect* clocks and defining a method of synchronization, leading to the *relativity of simultaneity* and to *time dilation*.

AE: Quite true. But my dear Professor, how else can one treat these issues?

HH: One can replace *space-time symmetry*, based on your assumption of multiple real worlds, each possessing its own $\vec{v}$-dependent time dimension, with **one** real energy-based world of kinetic energy $\sim v^2$ (and gravitational energy $\sim mGz$). My theory of electrodynamics [1] for bodies in motion is *energy-based*:

> *" … in every self-contained electromagnetic system the amount of energy in question is balanced by the mechanical work which is done by the electric and magnetic ponderomotive forces of the system during the element of time under consideration."*

Since *clocks* represent mechanical work, defining them as "perfect" is a vast oversimplification. Should one radically alter the nature of time and space, as you have done, on the basis of such oversimplification?

AE: I await your elucidation of a better approach.

HH: It might be appropriate here to summarize the situation that has developed. Since our dear tavern keeper has spent far more time in the 20th century than have I, perhaps he will be kind enough to do so.

From physics to geometry

TK: In a recent physics textbook, Thorne and Blandford [40] define Einstein's *Principle of Relativity* as:

> *"Every… law of physics must be expressible as a geometric, frame-independent relationship among geometric, frame-independent objects* [in space-time]*."*

The derivation of the Lorentz transformation from one 4D-coordinate system to another such system in relative motion is *geometrical* in nature, based on the assumption of *space-time symmetry*. This symmetry is non-intuitive; it doesn't make sense. Rindler [7], whose name is attached to aspects of special relativity, says of Einstein's postulate: *"Light propagates the same in all inertial frames… It is not for us to ask how!"* If it did make sense, we could ask how, therefore Rindler is admitting that it doesn't make sense.

This is why Susskind [19] states: "*Special relativity… is counterintuitive… full of paradoxical phenomena. My advice is that when confronted with one of these paradoxes*, you should *draw a space-time diagram*." In other words, don't try to solve with logic, *use geometry*. Similarly [40] "*the nature and geometry of Minkowski space-time are far less obvious intuitively* [so…] *develop space-time diagrams…to study length contraction, time dilation, and simultaneity breakdown*."

> *"A paradox is a statement that, despite apparently sound reasoning from true premises, leads to an apparently self-contradictory or logically unacceptable conclusion."* Wikipedia

TK: One's instinct, on encountering such a logically unacceptable conclusion while reasoning from true premises, is to question the premises and so we do. But an immediate question is *why, when logic fails*, should we "*draw a space-time diagram*"? In other words *when logic fails why turn to geometry?*

A friend noted that "*geometry is quite logical*". But the logic of Aristotle and the geometry of Euclid would not be celebrated separately if they were the same thing. So geometry, which does depend upon logical reasoning, is not *just* logic; it is *logic plus*. Still the question is, "*why, when logic fails, are we advised to "draw space-time diagrams*"? The failure of logic relates to "*the symmetry of space-time*", related to *no preferred frame*, and characterized by "*the relativity of simultaneity*".

The logic of cause-and-effect fails

TK: If the question "*which occurred first*" cannot in general be answered due to the *relativity of simultaneity*, then *logic of cause-and-effect fails* and for many cases logic goes out the window. What changes in the space-time diagram? Space-time diagrams always have a *preferred frame* – one time axis is *more vertical* than the other (if *t* is vertical, *t'* has a slope) therefore as soon as we draw *x* and *t* axes, we effectively choose a *preferred frame*; the relativistic symmetry involved in the logic cannot be represented in one space-time diagram. Of course if there is only one universal time dimension, the space-time diagram is completely unrealistic; it is an assumption, and recall that one cannot prove an assumption. Recall also that we are here because logical reasoning failed; else we would not have a paradox.

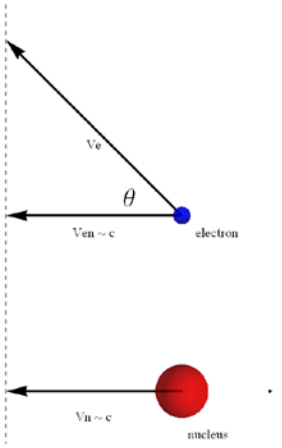
Note also that one cannot *prove* the contraction of the Lorentz transformation, either. The point is that each observer, *at rest* in his own inertial reference frame can make measurements *in his own frame* and "wants to know" what the measurements would read if he were in the other inertial frame. He **cannot** simultaneously be in the other reference frame, but the Lorentz transformation allows him to calculate 'what would be the case' if each frame has its own (velocity dependent) universal time dimension, as assumed by Einstein in his very definition of inertial reference frame; the basic ***false premise is built-into the definition used in Einstein's relativity principles***: (*same laws, same speed c – in all frames*); these *principles/axioms/assumptions/premises* are then logically argued, leading to the theory of special relativity. The definitions are never argued; the reason logic has failed to defeat relativity for over a century.

HH: The problem is that *Special Relativity* is a **geometric** theory, while reality is **physical**. Geometry preserves shapes and connections between relative positions and sizes, while *physics is energy based.*

> As the wind catches the front door, several new customers enter the tavern. Spotting one, the Tavern keeper invites him to the table…

TK: Monty! So glad to see you out on this stormy night. Please. I'd like to introduce you to these marvelous gentlemen… In fact, we were just discussing a topic you brought up the other day. Do you recall your remarks about Lorentz contraction?

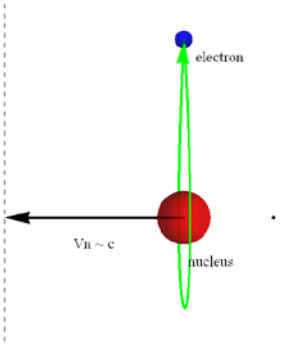
Monty: Why yes. If we assume an electron in orbit about a nucleus when the nucleus approaches the speed of light, then unless the velocity vector of the electron is perpendicular to the nuclear velocity, the component of the electron velocity projected onto the nuclear velocity will approach the speed of light.



If, in the limit, $v_{eN} = v_e \cos\theta = c$ then $v_e = c/\cos\theta \;\Rightarrow\; v_e > c$. So $v_e \le c$ can (by hypothesis) be true only if the electron velocity $\vec{v}_e$ 'contracts', and the atom is effectively 'flattened'. Why is that not a satisfactory 'explanation' of Lorentz contraction?

TK: *Because it is not a physical explanation.* It's a *geometric* argument based on vector geometry. A physical argument deals with any mass-based physics that causes the electron configuration to be altered. For example, from general relativity we know the gravito-magnetic circulation induced by the nuclear mass density ρ_N is

$$\vec{\nabla}\times\vec{C} \sim \rho_N \vec{v}_N .$$



This represents a gravito-magnetic field circulating at right angles to the nuclear velocity $\vec{v}_N$. Moreover, the electron mass moving in this field will experience a Lorentz force:

$$\vec{F} \sim m_e(\vec{v}_e \times \vec{C}) .$$

The key aspect of this equation is that when $\vec{v}_e$ is parallel to $\vec{C}$ then $\vec{v}_e \times \vec{C} \equiv 0$ and there is no force of the C field exerted on the electron; otherwise a force is exerted on electrons that will alter their velocity. Assume that the altered electron velocity eventually becomes parallel to the circulating C-field induced by the nucleus traveling near the speed of light. In this case the electron velocity $\vec{v}_e$ is orthogonal to nuclear velocity $\vec{v}_N$ ($\vec{v}_e \cdot \vec{v}_N = 0$) hence the component of $\vec{v}_e$ on $\vec{v}_N$ is zero, which satisfies Monty's argument that the component of $\vec{v}_e$ on $\vec{v}_N$ direction cannot be c.

There are several relevant points… the first is to reiterate that *the vector argument is non-physical* – it is a geometric requirement this says nothing of any physics required to instantiate or implement the result. In contrast, the general relativistic argument is physical, dealing with the inevitable C-field circulation induced by nuclear mass moving almost at the speed of light and an electron interacting with this field.

This illustrates the *First Rule of Reality* — projecting mathematical structure (vector calculus) onto physical reality can have no effect on physical reality. Only physical interactions generate real effects.

The second point of this example is that the *contraction* (seen here as *flattening* of the electron orbits) that actually occurs is not Lorentz contraction, per se. The Lorentz contraction of special relativity is simply another projection of mathematical structure onto 'space-time', *it is not physics!*

As we are focused on special relativity we postpone showing that the C-field mechanism just suggested is feasible. At the moment we can simply consider it an example of *physical explanation* versus *geometric explanation*. However Clifford Will [47] has recently analyzed the interaction between Mercury's motion and the gravitomagnetic field of the moving planets, which he shows to be 100 times larger than the second-post-Newtonian contribution [today's preferred approach].

From geometry to physics

TK: Returning to physics, the relativistic momentum is $mv\gamma$. Believing that the Fizeau experiment had *proved* the law of velocity addition, [which we have seen to be questionable] Lucas and Hodgson state (p.191):

> *"We then have to choose between defining the mass as m and the velocity as γv, or the mass as γm and the velocity as v. It is repugnant to have the mass depending on velocity, whereas we know that the velocities behave in a non-Newtonian way…" Yet,*

Repugnant! So, based on esthetics, they choose Lorentz-velocity γv instead of relativistic mass γm. But our results imply that *velocity* is Galilean, not Lorentzean, so we choose γm as the relevant association of rest mass plus kinetic energy. If this is the case we propose to switch from *geometry* to *physics* by changing from the *space-time* interpretation in terms of x and t to the *energy-time* interpretation terms of m and t, where m represents the *mass-energy* parameter:

$$(x,t) \rightarrow (m,t)$$

The geometrically-defined and derived Lorentz *space-time transformation*

$$x' = \gamma(x - \dot{x}t)$$

then becomes the physically-defined Lorentz *energy-time* relation

$$m' = \gamma(m - \dot{m}t).$$

Since special relativity excludes acceleration, $\dot{m} = 0$, and hence (using m_0 as rest mass) $m = \gamma m_0$. When *space-time* is replaced by *energy-time*, the Lorentz factor is applied to *mass-energy*, invalidating *Einstein's Lorentz-velocity formalism*, so one might ask how transformations in space and time actually *do* work. Relativity texts [34] claim that the Galilean transformation $x' = x - vt$ *"is adequate, as a translation rule between* [3D] *frames moving in uniform velocities with respect to one another for all classical … mechanics, but not for electromagnetism."* Yet we have seen that Maxwell-Hertz equations based on the convective derivative *are* Galilean invariant. Thus transfer in space and time *is* and *always has been* properly described by the *Galilean transformation*, and we thus have *the energy-time equations*:

$$x' = x - \dot{x}t \qquad \text{Galilean velocity transformation}$$

$$m = \gamma m_0 \quad \Rightarrow \quad mc^2 \cong m_0c^2 + m_0v^2/2 \qquad \text{Lorentz energy transformation}$$

Significantly, Lucas and Hodgson point out:

> *"…if we insist on retaining Newtonian dynamics, and the Newtonian definition of velocity and acceleration, then we can still obtain relativistically correct results if we pay the price of allowing the mass to depend on the velocity."*

This is a major admission worth repeating:

> *We obtain relativistically correct results based on relativistic mass and Galilean velocity!*

HH: So, Professor Einstein, your derivation is *geometric* in nature, not *physical*. The geometric approach to inertial frames in relative motion is based on *projecting* 4D-coordinate systems onto objects, and treating the frames as physical objects instead of mathematical structures having no physical reality. Yet [34]

> "*Instead of differentiating between geometry and physics,* [Einstein] *sought to identify them…*"

Can physicists *unlearn* the geometric-prescribed symmetry of space-time (no preferred frame)? Our experience is that physicists are not prepared to easily understand that, as Lucas and Hodgson say: p.234,5:

> *"Scale-indifference plays an important part in differentiating the parts played by geometry and physics… Geometry… put*[s] *as few constraints as possible upon the way we refer to and characterize positions and figures in space, while leaving to physics the task of not just describing, but of exploring why phenomenon are as they actually are. If this difference of role is accepted – and it is a big 'if' –* ***geometry needs to be subject to more symmetries than physics****."*

Einstein's geometric space-time worlds require a Lorentz symmetry group, but our energy-based physical world does not! So the interested physicist asks: "*How does one distinguish 'geometry' from 'physics'?*"

- *Geometry does not have mass terms;* $\{x, y, z, t\}$ *suffices.*
- *Physics has mass terms:* $\{x, y, z, t\}$ *does not suffice –*

And the mass is <u>inertial</u> mass, which *resists acceleration*, including acceleration of any restoring force!

Also, independently of Lucas and Hodgson, mathematician Zimmer postulated that "*the more dimensions a geometric space has, the more symmetries it can have*." Brown, Salazar and Fisher proved Zimmer's conjecture true [48], by showing that "*below a certain dimension, the special symmetries cannot be found*. Space-time as constructed by Einstein, with multiple universal times and 4D geometries, $\{x, y, z, t\}$, and $\{x', y', z', t'\}$ has length contraction and time dilation from Lorentz symmetry group, whereas if physical reality is based on universal time and space (3D+1) then Lorentz symmetry cannot exist! Einstein's basic assumption, never argued or proved, is that the time dimension in each space-time world is universal in that world. This demolishes the intuitive understanding of time as *Absolute* – universal time as universal simultaneity – *it's <u>now</u> at every point in our spatial universe*. In place of intuitive time we get *the relativity of simultaneity* implicit in multiple times.

Physics, after a century of *geometricization*, is quite comfortable with this approach. This is not without consequences:

> *When one's framework is geometric, one asks questions about 'worm-holes' in space-time.*
>
> *When one's framework is physical, one asks questions about the topology of stable energy flows.*

In the following we ignore Einstein's geometry and focus on the energy-momentum physics of relativity.

Space-time Symmetry vs. Energy-time Conjugation

TK: The well-known solutions of the wave equation, whether expressed in exponential or sine waves such as $\psi = \sin(\vec{k}\cdot\vec{r} - \omega t)$, employ the phase $\vec{k}\cdot\vec{r} - \omega t$. This phase involves a product of the space and time coordinates $\vec{r}$ and t times the wave parameters, the propagation constant $\vec{k}$ and frequency ω. We can mathematically transform the phase by transforming the space and time $\vec{r}$ and t **or** by transforming the propagation constant $\vec{k}$ and frequency ω. Unfortunately, Voigt [25] inappropriately chose to represent the Doppler effect as a transformation in the *space and time coordinates* for a stationary observer to those for moving observer, leading to the naïve assumption that *space and time* themselves could somehow change in the moving system, and resulting in 'length contraction' and 'time dilation'. Lorentz compounded this mistake. However the Doppler effect is concerned solely with *wave properties*: the propagation constant $\vec{k}$ and angular frequency ω; the phase velocity v and the velocity of energy propagation c, so the transformation should have been in terms of frequency ω and momentum $\vec{k}$. In other words, in terms of *energy* and *momentum*.

Also consider that classical Poisson brackets provide that, for function F, the time derivative is given by $dF/dt = \{F, H\}$ with momentum time derivative $dp_k/dt = \{p_k, H\}$. The Hamiltonian, H, or energy function, corresponds to change with time, formalized in quantum mechanics as the *energy operator:*

$$\hat{H} \sim \frac{d}{dt} \qquad \text{with } \textit{momentum operator}: \qquad \hat{p} \sim \vec{\nabla}. \tag{8}$$

Newtonian mechanics is not Lorentz-invariant – it thus allows particles to be accelerated to arbitrarily large speeds.[7] The Lorentz factor $\gamma = (1 - mv^2/mc^2)^{-1/2}$ must be added to Newtonian mechanics to make it compatible with the speed of light as the ultimate speed. Yet, before the twentieth century only a single case of irreducible failure of Newtonian mechanics was known, the advance (43 arc-sec/century) of the perihelion of Mercury, and even this would have been handled by Heaviside's gravito-magnetic equations if only he had realized that the gravitational field is self-interacting! Particle physics *requires* the Lorentz factor to transform between energy states, but none of this requires, or even suggests, space-time symmetry. In fact, Rindler,[7] asked how we would modify Newton's first law if we had just discovered relativity, concluded that

$$m = \gamma(v)m_0, \quad \vec{p} = m\vec{v}, \quad E = mc^2$$

is sufficient. He next generalized from the mass contribution of kinetic energy to *all* forms of energy:

> *"If every form of energy has mass, we would expect light to have mass and thus to bend in a gravitational field… [as observed.]"*

Interestingly, while Lorentz transformation is derived in terms of two observers, each in their own rest frame, this is not generally useful in relativistic many-particle mechanics. As Rindler notes:

> *"…we quickly get into a bad tangle of different γ-factors."*

Instead, "*we can always find a (clearly unique) frame… the center of motion frame*." But a 'clearly unique' frame is a *preferred* frame, and in this frame the relative velocities are not limited to *c*, but can be as high as 2*c*. Moreover, in relativity the center of mass frame is *not* uniquely determined, since in the rest frame of either particle the other particle is the more massive (by *space-time symmetry*) so the effective rest frame of the system exceeds the masses of the parts in the center-of-mass frame. In other words,

the 'relativity of two frames' is often worthless in particle physics and instead one must typically resort to colliding beams and a center-of-mass frame that is always a locally absolute *preferred* frame.

Emmy Noether's fundamental theorem related conserved quantities in physics to symmetries of the laws of nature: space translation symmetry yields conservation of momentum; rotation symmetry yields conservation of angular momentum; and ***time translation symmetry yields conservation of energy***. In most physically relevant cases, the Hamiltonian is the total energy. When expressed as operators on appropriate functions $F \to \psi$ we obtain the basis of quantum mechanics, Schrödinger's equation:

$$i\hbar \frac{d\psi}{dt} = \hat{H}\psi \tag{9}$$

All of this implies that the difference in *rest frame energy* and the *energy of mass moving* with velocity $\vec{v}$ is linked to *change with respect to time*: d/dt. Even in your photo-electron paper: $E = h\nu$, $\nu = frequency = cycles/\text{sec} \sim d(cycles)/dt$. And of course Pound and Rebka demonstrated change in frequency with gravitational energy, as is proved every day in the *global positioning system* (GPS) yet:

> *"The belief that space-time actually described reality has led to numerous misconceptions about the nature of space and time. These are distinct phenomena, and are not fused into some 4D-entity."*

Professor Einstein, the concept of *time dilation* arose from assignment of a universal time dimension to *every* inertial reference frame. Lorentz transformation between two 4D inertial frames mixes time and space dimensions in a way that makes no physical sense at all; it is simply a formal mathematical 'rotation' unlike things in 3-space and 1-time. In abstract geometry terms the transformation is legitimate; in terms of physical rotation of the time direction into a space direction, it is pure nonsense. In reality the 4D space-time is split into 3D+1; the 3D and the 1D do <u>not</u> rotate into each other. The 3D+1 *split* is instead formulated in terms representing energy and momentum: $E, \vec{p}$. Since both energy and momentum <u>do</u> contain a mass term, the relativistic mass $m = \gamma m_0$ associates the Lorentz energy factor with each term in the 3+1 split of the four momentum vector: { *energy, momentum* }. In fact, the use of 4D gauge physics does *not* require belief in (or even the concept of) the multiple time dimensions of special relativity: [20]

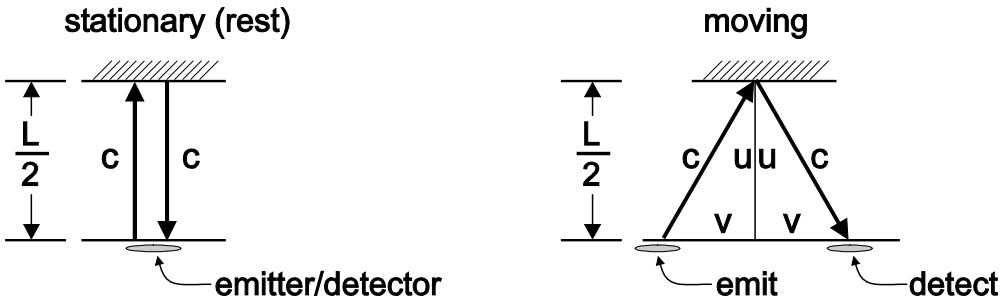
$\{E, \vec{p}\}$	$\{\partial/\partial t, \vec{\nabla}\}$	$\{\phi_q, \vec{A}\}$	$\{\phi_m, \vec{v}\}$
Classical Mechanics	Quantum Mechanics	Electro-Magnetics	Gravito-Magnetics
$E \sim p^2$	$(\partial/\partial t \sim \nabla^2)$	$E \sim d\phi_q/dt$	$G \sim d\phi_m/dt$
		$B \sim \nabla \times A$	$C \sim \nabla \times v$

The *one-frame derivation* of the Lorentz energy factor is thus compatible with relativistic particle physics but <u>not</u> with non-intuitive space-time symmetry; it implies *only* ***one*** *time dimension. Clocks measure energy*, only indirectly related to *fundamental time*, that is, *universal simultaneity*. In terms of universal time (absolute simultaneity) the concept of time dilation is meaningless. Time *flows* equably throughout the universe, and *does <u>not</u> change locally based on condit*ions. On the other hand the local measurement of duration *is* achieved by counting local cycles in a physical system, and these cycles can be affected by local conditions. **So *time* does not dilate, or alter based on local conditions; *clocks* do**.

Perfect clocks do not exist and clocks do not measure time, per se, they measure energy-based cycles by counting. *Energy-time conjugation* allows us to consider the cycle count <u>as if</u> it were a measure of time, but that is an abstraction every bit as non-physical as observing time in two different inertial frames.

Apparent Time Dilation

TK: Despite that time is universal in the Galilean frame, we find that the radar measurement of time yields an *apparent* time dilation, in that the moving clock appears to run more slowly. This is because the path of light travels from emitter to detector is longer when the detector is moving. The apparent time dilation is $dt/d\tau = \sqrt{1-v^2/c^2}$ or $d\tau = \gamma dt$ where dt is actual time and $d\tau$ is the result of the "*radar measurement of time*". Observe that the nature of time is not changed; the nature of the radar 'clock' has changed, in the sense that the path over which the radar pulse travels has lengthened.



The same radar pulses, reflected from a mirror a known distance from the transmitter, establish a 'clock tick'. If the radar is in motion the time will appear to slow down with respect to measurement of time in the rest frame.

Einstein: And of course, the radar clock must be symmetrical.

TK: Actually, in our railway car, if we believe we are at rest, and that the station is moving with respect to us, *the logic is the same*, but *the belief is false*. **If gravity establishes the rest frame**, the stationary clock will always be 'faster', in the sense that the light travels the shortest distance in the rest frame.

Hertz: So it seems clear that local velocity-related energy-change in **one** inertial frame, *the real world*, should be thoroughly analyzed *before* one takes the radical step of proposing a new time dimension.

Einstein: Perhaps, but, my *gedanken experiments* led to *length contraction* and *time dilation*, as proved by muons and atomic clocks. And I clearly formulate my space-time frameworks using *perfect clocks*.

Perfect Clocks

TK: Ah ha! That may be the problem. ***What is a perfect clock?*** The first clocks derived from pendulums, and even in 1500 it was known that pendulum clocks at different geographical locations varied, since the period being counted is $\sqrt{l/G}$ where l is the length and the local gravity $\vec{G}$ varies due to the oblateness of the earth. Indeed, whether *wound spring*, *tuning fork*, or *local crystal oscillator*, all clock mechanisms are subject to local conditions. For example, a quartz-crystal-micro-balance measures adsorbed mass because *its frequency changes* when molecules are adsorbed. But its frequency also changes when the temperature of the piezoelectric crystal changes so we use temperature-controlled quartz-crystal-micro-balances. Finally, all realistic clocks that are able to measure relativistic time changes are atomic clocks, based on characteristic emission lines such as rubidium[87] and cesium[133]. But even atom-atom scattering shifts the frequency of atomic clocks [13].

In other words, Einstein, *there are no perfect clocks* — all are subject to local energy conditions. You entirely ignore this reality; positing 'perfect clocks' and a method to synchronize perfect clocks, and then you **imagine** the clocks measuring *different time dimensions*. It would seem that a more sober approach

would have been to ask how clocks are affected by local energy, such that a clock at rest in a universal time dimension might read differently than another clock moving in the *exact-same-one-and-only time dimension* with different energy $\sim mv^2$. This *clock difference* is of quite different nature than assuming that the non-local moving clock is measuring a *different time dimension!* By definition, if the clock is moving with velocity $\vec{v}$ with respect to our rest frame, it possesses energy $\sim mv^2$ with respect to clocks at rest in our frame and this may well affect the 'cycle counting' that we interpret as 'measuring time'.

HH: Yes, consider the photon energy $h\nu$ that describes all atomic clocks used to "prove" time dilation:

$$E = h\nu \sim \frac{d}{dt}(cycles) \qquad \text{where} \quad \nu = \frac{c}{\lambda} \ \text{(rest)} \quad \text{and} \quad \nu = \frac{c-v}{\lambda + \Delta\lambda} \ \text{(moving).} \qquad (13)$$

AE: But what about the muon? It lives nine times longer than it would in its rest frame.

HH: It certainly does. But why? Is that a *space-time symmetry* effect? And, if so, does the same logic apply to the neutron, which lives for fifteen minutes as a free particle, but billions of years in the nucleus?

AE: My dear Sir, nucleons in the nucleus are in a vastly different energy environment or ground state.

HH: That is indeed true, and a muon traveling at 0.997 c also exists in a vastly different energy state. My dear Einstein, are you claiming that energy differences affect the neutron, but such do not affect muons?

AE: Hmmm… [*reloading and lighting his pipe*] I may have to ponder that point.

TK: Pound-Rebka showed that even a 25 meter gravitational energy shift changes a photon's time period. **Fundamental reality is based on *energy-time conjugation,* $\Delta E \sim 1/\Delta t$, not on *space-time symmetry*.**
If we approach with speed v, a light wave moving in local gravity with speed c, then we will see light with speed $c+v$, contradicting your basic principle. In fact *this very day as we meet*, two new tests of relativity are reported [22, 23]. One tests an electromagnetic field holding a superconducting niobium sphere against the gravitational pull of the earth, and finds no compelling evidence for Lorentz violation, but the null results are compatible with '*gravity as ether'*. The other uses 48 years worth of *Lunar Ranging* data to conclude that "*no Lorentz violations were found*". Neither test is based on the existence of two time frames, so in both tests, the '*relativity survives scrutiny*' conclusion is meaningless!

The *energy-time interpretation of relativity* is based on a universal time frame in which moving objects have energies proportional to v^2. Energy-time conjugation means the resonant frequency of the mechanical system will change with energy, hence with velocity. Quantum theory: minimum change $\Delta E \Delta t \sim \hbar$

Clocks are always implemented as cycle counters so **clocks actually measure energy, not time**.

Clocks responding to local energy-changing conditions read differently according to their velocities. This does *not* imply another time dimension in any way. Lorentz transform describes *physics energy relations* in **one** time dimension, the real physical world; it has no significance outside the realm of kinetic energies and gravitomagnetic circulation. Lucas and Hodgson [34] state:

"Einstein's critique of the common-sense concept of time and simultaneity does not really convince."

As for the 'time dilation' claimed to be confirmed by quantitative experiments, they say: *"If it were not so confirmed, we would have to think again."* Indeed, we will find that 'thinking again' allows for *re-interpretation* of the underlying physics.

The theory of inertial clocks

TK: Einstein's *perfect* clocks were *massless*. They were imagined inventions that could be placed anywhere in an inertial reference frame and assumed to accurately measure the time in that reference frame. But massless perfect clocks do not exist. *All* real clocks are based on counting mechanical cycles of oscillators, all of which operate based on elasticity and inertia, with a frequency (count):

$$\omega_0 = \sqrt{\frac{elasticity}{inertia}}\,.$$

For simplicity we consider the oscillating mass on a spring governed by restoring force $-kx$ where k is the elasticity and x is the displacement from the equilibrium displacement, $x = 0$: $F = ma = -kx$. If we let $m = \gamma m_0$ and $a = \ddot{x}$ and $\omega_0 = \sqrt{k/m_0}$ = frequency of clock at rest, then

$$\ddot{x} + (k/\gamma m_0)x = 0 \quad \Rightarrow \quad \ddot{x} + \frac{\omega_0^2}{\gamma}x \quad \Rightarrow \quad \ddot{x} + \omega^2 x = 0$$

and when clock mass m_0 moves with velocity $\vec{v}$,

$$\omega^2 = \frac{\omega_0^2}{\gamma} \quad = \quad \sqrt{1 - \frac{v^2}{c^2}}\ \omega_0^2$$

Thus $\omega < \omega_0$ and the frequency of oscillation is lower, hence the count of oscillator cycles is lower, hence *the moving clock runs slower*. So unlike Einstein's imagined *massless perfect* clocks, all *real* physical oscillating clocks have rest frequency ω_0 which oscillates more slowly when inertial mass increases. The physics of various clock mechanics is both complicated and well understood, and in *every* case the fundamental frequency is inversely proportional to inertia. Relativistic particle physics is interpreted according to the *energy-time conjugation interpretation*, if τ is the period and $\omega_0\tau = 1$ then

$$\tau \approx \sqrt{\frac{inertia}{elasticity}} = \sqrt{\frac{f(m = \gamma m_0)}{elasticity}}\,.$$

Clocks run more slowly as inertia increases, i.e., per γ.

The Global Positioning Systems (GPS) clocks

TK: The GPS has been fully operational for decades, consisting of atomic clocks which have had work done to place them in orbit – mechanical work that alters gravitational and kinetic energies. *Time dilation* due to gravitational work was demonstrated by Pound and Rebka [49], who measured the photon frequency change due to ~25 meter altitude change of gravity: a clock rate increase corresponding to weaker gravity.

With dozens of satellites that must "*talk to one another*" and to a *master clock* on the ground, the use of dozens of γ's becomes impractical, yet relativity offers no way around this. *Every* clock in relative motion possesses its own dilating time dimension. How can the system be synchronized and remain in sync? The nature of precise orbit control allows both gravitational energy change and kinetic energy change to be known in advance, and thus to be compensated for. Clocks on the ground are designed to run the same rate when they are finally in position. If clocks 'tell time', and *each time is different*, how can this be?

As we have noted, clocks do not measure time – *clocks measure energy*. Specifically, clocks measure the frequency of atomic emissions between states of different energy. These states can be predicted when the gravitational and kinetic energy changes are known beforehand. But this implies that the relevant frequencies will differ for satellites and the master clock on the ground. Let us assume that the frequency ν_k of the k^{th} clock can be predicted. If ν_0 is the frequency of the master clock on the ground, then physics tells us how many cycles N_0 must be counted in order to 'measure' one second of duration. When we construct counters that count N_0 cycles, we've built an accurate atomic clock that measures energy $h\nu_0$ and translates to time t_0. However the gravitational and kinetic energy changes to be experienced by the k^{th} atomic clock are such that instead of ν_0, the frequency ν_k will be lower. If dt is the cycle time of the stationary master clock then $\nu_0 = 1/dt$. But $d\tau$ is the proper time of the moving clock so $\nu_k = 1/d\tau$. Since $d\tau/dt = 1/\gamma$ then $d\tau = dt/\gamma$ hence

$$\nu_k = \frac{1}{d\tau} = \frac{1}{dt/\gamma} = \frac{\gamma}{dt} = \gamma\nu_0 .$$

So time dilation of the moving clock $d\tau < dt$ corresponds to the frequency relation $\nu_k = \gamma\nu_0 < \nu_0$. For simplicity we ignore gravity, although of course gravitational energy changes must also be calculated. Thus if $N_0\, dt$ = *one second*, we must count N_0 cycles of the stationary frequency to yield the calibrated atomic clock. In orbit the cycles are of shorter duration ($d\tau < dt$) so $N_0\, d\tau < N_0\, dt$ and the orbital clock "runs slower", that is, it takes longer to reach one second. [*The secondhand moves slower*.]

A physicist who believes that time runs differently for each moving object may be stuck at this point, but an engineer can, by changing the count, design 'clocks' that run at the same rate in orbit as on earth.

$$N_0 = \frac{one\ second}{dt} \quad N_k = \frac{one\ second}{d\tau} = \frac{one\ second}{dt/\gamma} \quad \Rightarrow \quad N_k = \gamma\frac{one\ second}{dt} = \gamma N_0$$

Hence the GPS corrected clock, because it runs at a faster rate than the proper time (orbital) clock must measure a value reduced by a γ-factor: $N_k = \gamma N_0$. Using properly designed clocks, time in orbit runs at the same rate as on Earth, and *time dilation* is seen to be an *artifact*, a false interpretation of what is essentially a measurement of energy, not time.

Ives-Stillwell time dilation

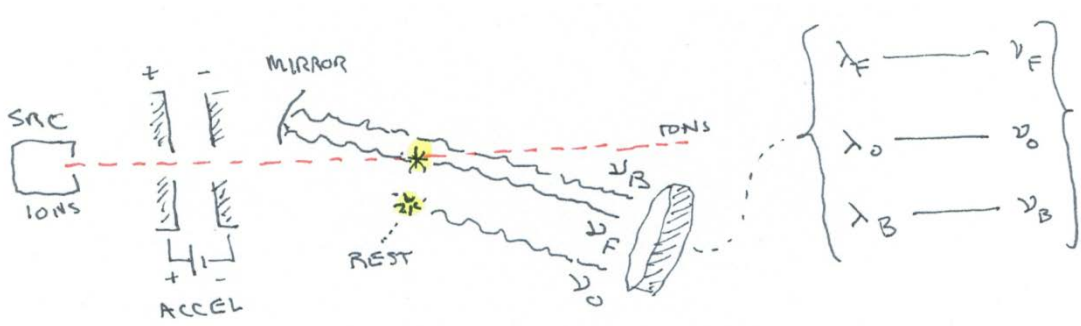
TK: In 1938 Ives and Stillwell performed the first experiment to test time dilation. To re-interpret space-time symmetry in terms of energy-time conjugation, we must explain Ives-Stillwell in these terms. We derived the Doppler shift from radar measurements and then derived the energy factor that differentiates the Galilean and Lorentz transformations. Ives and Stillwell assumed that *both* of these effects were present and designed their experiment to separate the Doppler from time dilation effects. They imparted energy to ions (H_2^+, H_3^+) by passing them through an accelerating electric field. The premise is that residual ions in the system provide a 'rest frame'.

The shift in time: $\Delta t = \gamma \Delta t_0 \quad \Rightarrow \quad \dfrac{1}{\Delta t} = \dfrac{1}{\gamma \Delta t_0} \quad \Rightarrow \quad \nu = \nu_0 / \gamma$

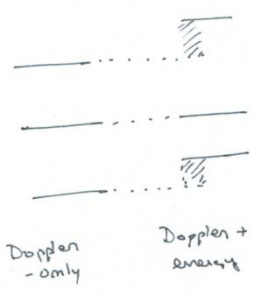
The shift frequency $\nu = \nu_0/\gamma$ represents time dilation. To this is added the forward Doppler shift ν_F and the backward Doppler shift, ν_B, representing photons emitted *backward* along the ion beam.

$$\nu_F = \frac{\nu_0}{\gamma}\left(\frac{1}{1-v/c}\right), \qquad \nu_B = \frac{\nu_0}{\gamma}\left(\frac{1}{1+v/c}\right)$$

The equivalent wavelengths $(\lambda = c/\nu)$ are given by $\lambda_F = \gamma\lambda_0(1-v/c)$ and $\lambda_B = \gamma\lambda_0(1+v/c)$. The three frequencies ν_0, ν_F, ν_B (or wavelengths $\lambda_0, \lambda_F, \lambda_B$) can be spectrascopically resolved and focused on the detector as shown below



The spectrograph shows ν_0 as characterizing the basic photon energy in the rest frame of the rest ion. The Doppler shift adds or subtracts from this rest frequency based on velocity $\vec{v}$ of the ion beam with respect to the rest frame. The forward and backward shifts are symmetrical and represent equal but opposite shifts corresponding to $+\vec{v}$ and $-\vec{v}$. Doppler shifts are produced for all ions in the moving beam; there are no equivalent shifts for ions at rest. Similarly, only ions in the beam are affected by 'time dilation', however this energy factor is independent of beam direction, and represents an additive shift for both forward and backward emitted photons.



The λ_0 wavelength was 4861 angstroms, while red shifted (backward) wavelength was 4885.1 and the blue-shifted (forward) wavelength was 4836.94. The averaged shifts are compared to the un-shifted wave-

length and the difference represents the relativistic γ-effect.[50] This establishes the reality of the energy change that is falsely interpreted as 'time dilation' in special relativity.

Einstein: Let me get this straight. In *Fizeau's experiment*, you claim that the measured phase shift for light flowing through water is a Doppler effect and *the relativistic effect is absent*. But in *Ives-Stillwell* you cancel the Doppler Effect and show the residual relativistic effect. Is there a discrepancy here?

TK: There is no discrepancy. We've shown that the Lorentz factor is *a relativistic-energy effect having nothing to do with velocity, per se*. The velocity-based physics is the Doppler phenomenon. Fizeau's experiment measured the Doppler shift of light in flowing water, while the v^2/c^2-based energy effect is too small to measure. Ives-Stillwell, on the other hand, cancels the Doppler effects, but by virtue of accelerating the charged ions the relativistic energy effect becomes large enough to measure.

The Relativity of Simultaneity and detection of *absolute motion*

Rose: Herr Professor, if I may speak. A short while ago I glanced out the window and I happened to observe two lightning strikes on the railroad. These lightning strikes were simultaneous from my perspective. M. Heaviside has informed me that the lightning rods by the railway are, by chance, equidistant from the tavern. Therefore, from the theory of *gravity as ether* the two lightning strikes were *simultaneous across space*, compatible with the meaning of universal time.

Einstein: Oh my dear, that opinion is mistaken. The fact that *you* are equidistant from the two flashes is fortuitous. The flashes are simultaneous from *your* perspective, in *your* inertial frame. But an observer in another inertial frame would not observe simultaneous flashes, hence the relativity of simultaneity.

Rose: But Professor, the observer on the train is moving in the gravitational field with constant velocity while the light flashes propagate toward him. Even if he happened to be equidistant from the lightning at the time the flashes occurred, he is in motion *toward one* and *away from the other*.

Einstein: But my dear, if he were equidistant from the flashes at the time they occurred, then he effectively is a simultaneity detector, by definition, and therefore if he does not observe the flashes at the same time, then they were not simultaneous.

Rose: Yes, Herr Prof; M. Heaviside explained to me that you defined a *simultaneity detector* as a device *placed midway between two events*, such as the 'simultaneous' lightning strikes on a railroad. If the detector detects *both* lightning strikes at the same time, you claim this means the events are simultaneous. But you then place a *second* simultaneity detector on a moving rail car, arranged so that the two detectors (static and moving) are *exactly adjacent* at the moment lightning strikes, and argue that, from the perspective of the moving railcar, the lightning strikes are *not* simultaneous, hence your *'relativity of simultaneity*'.

Einstein: Quite correct, my dear.

Rose: Professor, I am but a simple waitress, but the logic escapes me. You do define a simultaneity detector as being at the *midway point* between the two lightning strikes, do you not?

Einstein: Quite right, what is the problem?

Rose: The problem, Sir, is that during the time that light from the strikes moves toward the midpoint, the *railway car is moving away from the midpoint*. But, by your definition, the simultaneity detector must be *at the midpoint to perform its function.* Once it moves away from the midpoint it can no longer detect simultaneity, and thus nothing at all is proved about simultaneity, one way or the other. How can this lead to any conclusions about the 'relativity of simultaneity'?

Einstein: My dear, you are looking at the problem from the perspective of *one* inertial frame, the frame of the railway station. From the frame of the railcar the detector remains at the midpoint.

Rose: Yes, but the physics occurs in the frame of the railway station. How can this change by placing an imaginary mathematical structure on reality? In the stationary frame the railcar's simultaneity detector is no longer a functioning instrument, and its output proves nothing.

Einstein: My dear, you're defining the railway station as a 'preferred frame', which relativity forbids.

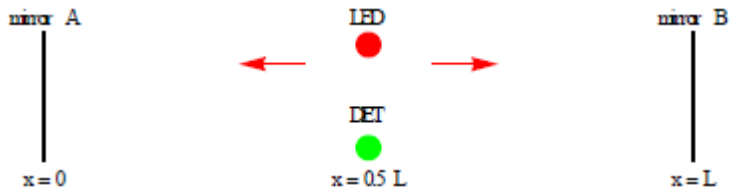
Rose: But have we not established that *gravity as ether* defines a locally preferred frame of reference?

Einstein: Yes, if gravity is the ether equivalent, your logic is correct.

Rose: The absolute splintering of time described in the phrase "*the relativity of simultaneity*" is pathological from the perspective of history of human understanding. Prof Einstein, you invoked 'perfect clocks' and a synchronization procedure; and defined a 'simultaneity detector', then pretended to logically conclude that 'simultaneity is relative'. But this was not logically concluded, it was built-in to the basic assumptions (which cannot be proved!) by your definition of 'inertial frame'. Relativity claims that one cannot measure the velocity of an inertial frame from within the frame. If we postulate gravity as ether, we can show this to be false. And, Esteemed Professor, it is this fact that allows one to measure absolute velocity, where absolute here means with respect to the local preferred frame.

Einstein: How might one go about such measurement?

TK: First we will simplify the physics. Instead of attempting to arrange for two lightning strikes to occur simultaneously at identically fixed distances from the simultaneity detector, we will place mirrored walls at each end of the railcar (as shown). Then we can measure the exact center of the railcar and place our detector at this spot. Finally, we also place a light source, say a light emitting diode, LED, at the exact midpoint, above the detector. We fire one light pulse which propagates toward both ends of the railcar. Since only one pulse is triggered, it is by definition simultaneous with itself. As an additional step, we use the initial detection of the pulse to trigger a stopwatch – we *'start the timer'*.



Now it is simple to solve the equations for when the light pulses reach the mirrored walls and are reflected back to the simultaneity detector, which remains midway between the walls. And is it proper to state, Professor Einstein, that, provided we use the Lorentz transformation, (*i) the speed of light is unchanged in all inertial frames, and (ii) it is not possible to detect absolute motion?*

Einstein: Why yes, those considerations are proper.

TK: But they are falsified if "*gravity = ether*".

Einstein: I understand your first claim of falsification, but how do you propose to detect absolute motion?

TK: We obtain the times for all events occurring in the experiment. The light reflected from mirror A will reach the detector at the midpoint of the car at time $t + t''$, which is the total time for light to travel from the midpoint (moving with velocity $\vec{v}$) to mirror A and return to the moving midpoint. Similarly, the light reflected from mirror B will reach the detector at the midpoint at time $t' + t'''$.

$$t_{A-path} = t + t'' \quad \Rightarrow \quad \frac{L}{2}\left(\frac{1}{c+v}\right) + \frac{L}{2}\left(\frac{1}{c-v}\right)$$

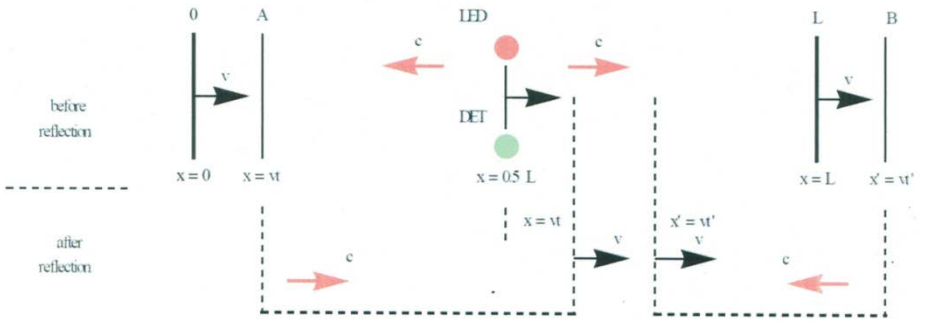
$$t_{B-path} = t' + t''' \quad \Rightarrow \quad \frac{L}{2}\left(\frac{1}{c-v}\right) + \frac{L}{2}\left(\frac{1}{c+v}\right)$$

We see by inspection that the times are identical, which, by Einstein's definition, says that the photons were emitted simultaneously, despite that our paths include reflections that were not specified in Einstein's unfeasible experiment, which depended on lightning striking at known places, or clocks

synchronized at one place then moved to different places, causing them to lose sync. But before proceeding, let's simplify the expressions for the times involved

$$t_{A-path} = \frac{L}{2}\left[\left(\frac{1}{c+v}\right)+\left(\frac{1}{c-v}\right)\right] = \frac{c-v}{(c+v)(c-v)}+\frac{c+v}{(c+v)(c-v)} = \frac{L}{2}\frac{2c}{c^2-v^2} \qquad t_A = \frac{L}{c}\frac{1}{\left(1-\frac{v^2}{c^2}\right)}$$

And t_B is the same.



Relations at t, the distance from mirror A to the midpoint is L/2. Now the light reflected from A is 'chasing' the midpoint, so the light will have to travel > L/2.

Relations at t', the distance from mirror B to the midpoint is L/2. The midpoint is 'approaching' th light from mirror B, it will have travel < L/2.

$$ct'' = L/2 + vt'' \qquad ct''' = L/2 - vt'''$$

$$t'' = \frac{L}{2}\left(\frac{1}{c-v}\right) \qquad t''' = \frac{L}{2}\left(\frac{1}{c+v}\right)$$

We notice from the following. If $v = 0$, then in the rest frame the total time from emission to detection, over either path, is $\tau = L/c$ or $L = c\tau$, which is the time for light to travel $L/2$, be reflected and travel back $L/2$. But if $v \neq 0$, time from start to finish is $\tau = \frac{L}{c}\left(1-\frac{v^2}{c^2}\right)^{-1}$. So *time depends on velocity* v.

But a key principle of Einstein's special relativity is that one <u>cannot</u> measure velocity v of the frame by any experiment performed within the frame!

Yet that is exactly what we have done. We find $v = \pm c\sqrt{1-\frac{L}{c\tau}}$.

We measured L before beginning the experiment; and we measure τ by starting a stopwatch when the LED is fired, and stopping the stopwatch when the opto-detector detects reflected photons. Thus if we plug the reading of the stopwatch into our velocity formula we obtain the velocity of the frame from an experiment performed entirely within the frame. This violation of special relativity is significant.

Inertia, translation, gravity and rotation

TK: We have seen how Einstein sneaked a false premise into his basic definition of *inertial frame*, and then formulated all of his principles of special relativity in terms of inertial frames. By so formulating his theory in terms of two 4D geometries [with no mention of mass!] he invoked symmetries [*the Lorentz group*] that do not apply to the physical world of *universal time*. After hiding multiple time dimensions in the basic definition – *which utterly destroys the idea of universal simultaneity* – he then pretended [via his faulty definition of a *simultaneity detector*] to logically 'derive' the *relativity of simultaneity*, all the while pretending (or believing) that 'perfect clocks' exist in massless form and can be placed at any relevant point (event) in *space-time*. From here he derives a number of paradoxes, already mentioned. But we concluded that the γ distinguishing Galilean transformation from Lorentz transformation has no association with velocity but instead represents the relativistic mass-energy increase of accelerated bodies.

Hertz: You describe real *physical* clocks, *all of which have mass* and *all of which count oscillation cycles*. Despite various clock mechanisms, the common factor of oscillating systems is the existence of a restoring force, which accelerates the moving mass back to the equilibrium position. Inertia resists change. If the inertial mass increases, the inertial resistance to the acceleration of restoring force increases and the system does not accelerate as fast in any cycle – that is, *the clock slows down*. This is a local energy phenomenon, having nothing to do with an *object-specific universal time dimension*. The net result of this is that 'length contraction' does not exist and 'time dilation' is preserved but completely reinterpreted.

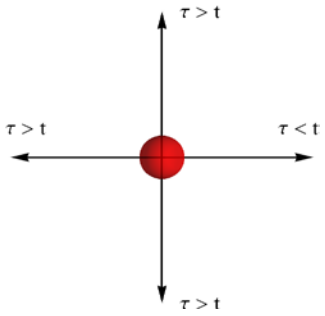
The Hafele-Keating experiments

TK: Prof. Einstein, consider flying laboratories launched from an airport as a sequence of relativity experiments, somewhat analogous to the MM labs performing the same experiment at various times in orbit. Is it correct to assume that any lab flying with velocity $\vec{v}$ will experience $\gamma(\vec{v})$ time dilation such that clock period τ in a flying lab is longer (slower) than the ground clock rate t with $\tau = t/\gamma(\vec{v})$? This gives a direction-independent *time dilation*, does it not?

$$\gamma(\vec{v}) = \frac{1}{\sqrt{1-\frac{\vec{v}\cdot\vec{v}}{c^2}}}$$ *North, South, East, West – all should be the same!*

Einstein: Yes, of course.

TK: Then I wonder how you explain this figure, which represents the results of the *Hafele-Keating experiments* for atomic clocks flown in four different directions from the same airport. Notice that three of the flights show the moving clock runs slower than the ground clock (red) while the fourth clock (at right) shows the moving clock running faster than the ground clock. However if, as John Bell stated [51]:



"Einstein declares the notions 'really resting' and 'really moving' as meaningless"

then it is almost impossible to interpret this experiment via special relativity. If the initial states of the parked aircraft are 'really at rest', then as both planes speed up and begin flying, their clocks should run slower than the clocks at the airport, but this is not reported. Instead, clocks on east-bound planes slow down with respect to the airport clocks, while westbound clocks speed up with respect to airport clocks.

Rose: As the proverbial question concerning the thermos bottle that kept the soup warm on Tuesday and the iced tea cold on Thursday:

"How do it know?"

How do clocks on planes know whether the airport is 'really resting' or 'really moving' when Professor Einstein says the question is meaningless? If the airport is *really resting*, all clocks on airplanes flying from the airport should slow down. So how do the planes judge whether the airport is at rest? Assuming no wind velocity at the airport, the plane's pitot-tube should indicate increased speed whichever direction the plane is flying. The airplane's radar should find that the planes are moving faster with respect to the ground regardless of the direction the plane is flying. Thus any 'relative motion' theory should predict that all clocks on all airplanes slow down with respect to airport clocks. The alternative seems to imply *'absolute space'* such that the planes are in absolute motion, not relative motion.

How do the clocks know whether to slow down or speed up, based on direction?

TK: The *Hafele-Keating experiment* [52] involved atomic clocks on aircraft flying around the world, one flying east and one flying west:

> *"…the* [relativity] *theory predicts that the flying clocks, compared to the reference clocks* [on the ground] *should have lost* 40 ± 23 *nanoseconds during the eastward trip and should have gained* 275 ± 21 *nanoseconds during the westward trip."*

which was confirmed when…

> *"…the flying clocks lost* 50 ± 10 *nanoseconds during the eastward trip and gained* 273 ± 7 *nanoseconds during the westward trip."*

Hertz: How is this compatible with special relativity? Or with the energy-time interpretation? From the perspective of the airport, both flights were in uniform relative motion, and therefore *both* flying clocks should have run slower than the airport clocks. *Yet one ran slower while one ran faster!* This truly does seem to contradict Einstein's claim that the notions *really resting* and *really moving* are meaningless.

If *all motion is relative* and *'resting' is meaningless*, then from the airport all flying clocks should be seen to slow down, yet one speeded up. In Einstein's view of Michelson-Morley, only ether could distinguish the different motions of the earth and the experimental lack of distinction (the null result) banished the idea of ether. From the *energy-time* perspective, the imparted energy $\sim mv^2$ is positive when bringing the aircraft from *rest* on the ramp to flying away with speed *v*. So how does the aircraft *know* its motion with respect to *absolute rest*? Pitot-tube measurements of *air speed* and ground-radar measurements of *ground velocity* only yield relative motion with respect to ground.

Einstein: But you have omitted that the observations are to be *with reference to the center of the earth.*

Rose: There are *no observers* at the center of the earth; the observers are at the airport and you are clearly selecting a *preferred frame*, which violates your basic *principle of special relativity*. In fact, motion of the center of the earth through space is ignored entirely, while relative motion of aircraft with respect to Earth's axis at any moment is taken into account, clearly violating relativity's 'no preferred frame' and your insistence that *the notions 'really resting' and 'really moving' are meaningless.* If only relative motions are considered, how do the aircraft observe anything but local motion relative to the airport?

Einstein: *How indeed?*

Relative or Absolute?

TK: The Hafele-Keating experiment is usually viewed as 'proof of relativity' since the airborne clocks demonstrate *time dilation*. However HK appears to challenge special relativity in fundamental ways – specifically the *relative-versus-absolute* claims of relativity.

Hafele-Keating complications go beyond the space-time symmetry of the two-body Lorentz formulation. From an energy-time perspective, the airport and all four aircraft are *initially at rest* with respect to the ground station; thus their initial velocities all yield $mv^2 = 0$ since $v = 0$. As each aircraft advances the throttle and picks up air speed, accelerating away from the airport, the relativistic mass increases: $m = \gamma m_0$. This increased mass increases the inertia and thus decreases the response to the acceleration of the restoring force that is at the heart of every clock. The increased inertia resists the restoring force and the acceleration is diminished. Since the key element of *every* oscillator is the restoring force that returns the mechanism to equilibrium position, and this now takes longer, *the clock runs slower*. **This is the energy-time interpretation of time dilation** by which every aircraft – including those heading North, South, East, or West – gains relativistic mass-energy and experiences *slower time* as measured by the oscillation-cycle-counter that constitutes the clock mechanism. Yet that is not what happens! A *direct-ional-dependent* clock behavior slows down for eastward flights; a west-bound clock actually speeds up.

Thus the meaning of this aspect of *relativity* is found only by bringing *the nature of* ***absolute*** *back into the picture! Only if the airport has an absolute velocity can we make sense of this violation of space-time symmetry*. That is, instead of the airport [and all parked aircraft] having a velocity $\vec{v} = 0$, we must assume that the airport has a non-zero velocity $\vec{v} = \vec{v}_A \neq 0$.

We can now make sense of the experiment from the energy-time perspective. With non-zero *rest velocity* the airport clocks have non-zero kinetic energy and thus already run slower than clocks at absolute rest. The airport travels west-to-east with a latitude-dependent velocity $\vec{v}_A$ where $[0 \le \vec{v}_A \le \sim 1000\ mph]$ so any individual aircraft can *increase or decrease* this velocity. If an aircraft flies eastward at $\Delta\vec{v}_E$ velocity (with respect to the airport), the absolute velocity is $\vec{v}_A + \Delta\vec{v}_E$ in the eastward direction. But if an aircraft flies west with velocity $\Delta\vec{v}_W$, then the *absolute* velocity is $\vec{v}_A - \Delta\vec{v}_W$, which can reach zero [the fastest the clock can run] and then it will start slowing down as it picks up speed in the westward direction!

Einstein's space-time symmetry vanquished *absolute time* via the *relativity of simultaneity* and *absolute space* via the *'no preferred frame'* axiom. But now we find that ***absolute time and space*** *must return in order to make sense of actual experiments.*

Hafele-Keating *violates space-time symmetry* by virtue of the *preferred* center-of-mass frame, and violates the *relativity of motion between objects* in favor of their comparison to an *absolute spatial framework* (the rotational axis through the center-of-mass of the Earth) from which bodies originating at an airport acquire aspects that change with time and acceleration, with respect to a preferred (absolute) direction.

Energy-time theory interprets clocks with mass m_a at the airport as having energy $E_a = m_a v_a^2/2$, leading to a cyclical-oscillation frequency ω_a. If v_a^2 increases such that $v_a^2 \to (\vec{v}_a + \Delta\vec{v}_E)^2$ the east-bound clock will slow down with respect to airport time. But if v_a^2 decreases such that $v_a^2 \to (\vec{v}_a - \Delta\vec{v}_W)^2$ then relativistic mass decreases, inertial resistance to a restoring force decreases and the clock runs faster. Nor are aircraft velocities relativistic: $\vec{v}$ is $\vec{v}$, with no γ-dependence; only mass $m = \gamma m_0$ is γ-dependent; any increase in inertial mass resists acceleration; things slow down – *moving clocks run slower*.

Hafele-Keating confirmed 'time dilation' and hence was taken to support special relativity, but the experiment requires a *preferred observation frame*, which violates special relativity and establishes the *absolute nature of rotation* – excluded from special relativity as *non-inertial*. This space-time symmetry violation prevents proper prediction by special relativity, which says the clocks on all four airplanes slow down. Relativity is wrong with its prediction that "*all moving clocks slow down*". To make sense of the HK direction-dependent results, we *must* relate the flights to the axis of rotation passing through the center-of-mass of the Earth. Without this preferred frame *relativity cannot explain* the local directional-dependence.

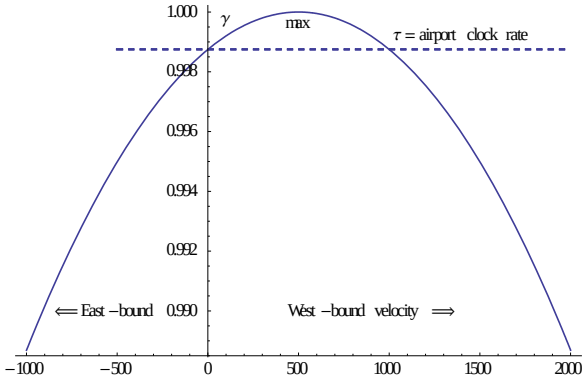
Hafele-Keating experiments do make sense based on *energy-based time dilation*, but it is necessary to give up the fiction that '*there is no preferred frame*.' Observer-specific coordinate frames fail to explain HK; the experiment cannot be interpreted correctly without using a center-of-mass frame, explicitly defining a preferred frame, thus violating the key space-time symmetry requirement. Recall that the center-of-mass frame at LHC accelerators was necessary to observe a relative velocity approaching twice the speed of light – forbidden by special relativity and declared absurd by Fock. Now the HK experiment requires the preferred frame to be identified with the center-of-Earth's-mass. This interpretation restores the *absolute*, supposedly vanquished by special relativity, now re-invigorated by East-bound flights that lose time while West-bound flight gain time – clearly connected to rotation about Earth's axis-of-rotation.

A fly-over time-dilation experiment

TK: Assume in the following that clock resolution is such that clocks can be accurately timed over a path, and we vary speed in successive flights along this path. Our energy-time interpretation of the *time-dilation* of the Hafele-Keating experiment depends on the existence of *absolute velocity* with respect to the rotation axis of the Earth. Points on the surface of the Earth, such as the airport, have latitude-dependent absolute velocity, assumed 500 mph West-to-East in this example.

Although HK obtained two clock readings, one for eastbound flights and one for westbound, we assume for discussion that we will obtain a series of clock readings (which correlate with clock rates) based on multiple flights along the path over the airport with different velocities. Our goal is to compare the clock on the aircraft to the airport clock as a function of velocity.

In the diagram below we depict the velocity of the aircraft with respect to the airport on the horizontal axis (in miles per hour) and the clock multiplier $1/\gamma$ along the vertical axis. The curve crosses the y-axis ($x = 0$) at ~0.98 yielding the clock rate for airport clocks (with scale factor $1/c^2 \sim 0.0001$). Recall that the airport is moving eastward with absolute velocity ~500 mph with respect to a static (non-rotating) Earth. Thus, if the plane departs the airport in an *eastward* direction, its speed increases and its clock slows down with respect to the airport clocks.



Hertz: If an aircraft flies *west*, it subtracts from the original velocity in the eastward direction hence the absolute velocity (with respect to Earth's axis) decreases, the local inertia decreases, and the aircraft clock speeds up. When the aircraft velocity is 500 mph, the craft has compensated for the airport velocity and its motion is at rest with respect to the earth's axis. Since a clock at rest has minimum inertia the clock rate is maximum, $\gamma = 1$. As westbound speed increases beyond 500 mph, the clock gains absolute inertia and the clock rate slows down as shown. When the west-ward velocity reaches 1000 mph, the aircraft has the same kinetic energy relative to the Earth's axis as when initially parked at the airport, so the aircraft's clock should run at the same rate as airport clocks [shown by dashed horizontal line]. If the aircraft then flies faster than $2v_A$ in the westward direction it should begin to slow relative to the airport. I conjecture that this behavior serves as *proof* of the *energy-time theory* instead of the *theory of space-time symmetry*.

TK: This experiment may have already been essentially performed and data may exist in the GPS system. I would not be surprised to find that relevant data could be extracted from the system.

Problems with 'ether drag'

Hertz: Relativity physics often invokes '*the relativistic dragging of inertial frames'*, where the inertial frame is a coordinate system in which Einstein postulated that the speed of light is constant. This is *unphysical* – the speed of light is attached to a mathematical projection – or it is *physical* and the medium of propagation for light is assumed to be dragged with the frame. In Fizeau's experiment *water* was assumed to drag the frame, but water does not appear to do so. How does Einstein's gravitational field drag the ether? Key to Einstein's ***gravity-as-curved-space-time*** is the reduction of gravitational theory to geometry, which precludes "*any recourse to the notion of gravitational energy*." In other words [53] p.12:

> *"Einstein defined formally the force of **gravity as a mere geometric property** of the fabric of four-dimensional space-time."*

TK: Yes, Einstein reduced the gravitational field to the *geometric interval metric structure of space-time* itself – in which *energy dynamics are expurgated*. Discussing *geometry versus physics* in relativity we saw that *geometry is based on symmetry of multiple 4D-coordinate frames*: $\{x, y, z, t\}$ and $\{x', y', z', t'\}$ with no consideration of mass, whereas physics requires the concept of mass and this includes the *mass equivalence of field energy*. When Einstein included the gravitational field – excluded from special relativity – in general relativity, he extended the geometricization of space-time into *curved space-time* – still with no concept of mass – hence *no field energy*. Local energy density of the field is not defined in GR. Special relativity redefined the nature of time and space by introducing [53] p.22:

> *"*[an] *artificial suspension of thought by **restricting itself to the problem of inertia and translation and ignoring gravity and rotation**.",*

despite that *every relativity experiment performed on earth is subject to both gravity and rotation*. By ignoring these essential aspects of the physics…[53]

> *"Relativity ceased being a scientific theory; to become an academic doctrine bandied about with the same arbitrariness as any other religious vision of the world."*

Hertz: *It is physical nonsense to speak of a pure space devoid of matter and energy; a platonic meta-physics of form.* Indeed, there is only one reason that Einstein insisted on a *geometric gravitational field devoid of energy*. When mass equivalence of energy is combined with the fact that mass *gravitates* or *sources the gravitational field*, then we are inescapably stuck with the problem that ***gravitational field energy gravitates*** – *a gravitational field creates more gravity and self-interacts*. A century of effort failed to formulate a solution to this, hence the problem is ignored. Nevertheless, as Huxley pointed out [59]:

> *"Facts do not cease to exist because they are ignored."*

TK: Physicist's ignorance of facts (and false premises) supports Hossenfelder [54] when she speaks of:

> *"…my growing suspicion that theoretical physicists are collectively delusional."*

To *explain* relativity experiments and the constant speed of light [Einstein attached to arbitrary geometries] we need *gravity-as-ether*. A naïve version explains MM's null result, but Monty Frost [55] discovered that more sophisticated gravitational ether is required to explain Michelson-Gale-Pearson (MGP):

- MM attempted to measure translation with negative result.
- MGP attempted to measure rotation with positive result.

We make sense of MGP's positive results, by viewing *gravity as ether* in terms of the gravitational field possessing local energy density – *a substantial field in which light propagates*.

The Michelson-Gale-Pearson experiments

Monty [*returning to the table*]: The *Michelson-Gale-Pearson experiment* supports *gravity-as-ether*, but implies that the *complete ether drag* analogy of static gravity is problematical. Both Newton's *Shell theorem*, and its extension to GR via the *Birkhoff theorem*, support a static *purely radial gravitational field* $\vec{G}$ relative to the center-of-mass of the Earth – $\vec{G}$ does not rotate with the Earth. *Birkhoff's theorem* says that the Schwarzschild metric is the *unique* spherically symmetric vacuum solution, such that *any spherically symmetric solution of the vacuum field solutions must be static and asymptotically flat.* This is a glorified version of Newton's *Shell theorem*, which states that:

> *"A spherically symmetric body affects external objects gravitationally as though all of its mass were centered at a point at its center."*

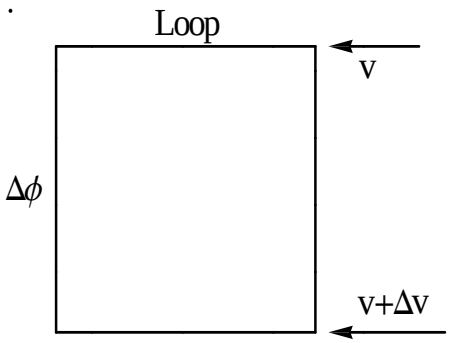
In some *ether drag* theories, the gravitational field was assumed to *drag the ether* with the Earth, in order to account for the null Michelson-Morley experiment results, but according to Wikipedia: [55]

> "[Ether drag] *theory was directly refuted by the Michelson-Gale-Pearson experiment* (1925). *The great difference of this experiment against the usual Sagnac experiments is the fact that the rotation of Earth itself was measured. If the ether is completely dragged by the Earth's gravitational field, a negative result has to be expected – but the result was positive."*

MGP experiments conflict with naïve *ether-dragging*; but do support *gravity-as-ether*. The static gravitational field radiating from the center-of-mass does not rotate with the earth, so experiments performed at the Earth's surface operate in a latitude-dependent *ether-flow* varying from zero velocity at the poles to ~ 1000 mph at the equator. This is below the resolution of the MM experiment, but MGP was designed to a scale that increased the resolution of the instrument, by building a *Sagnac-loop* ~1 km on each side. In other words, MM failed to detect the latitude-dependent rotational velocity of the Earth through the medium of light propagation because their instrumental resolution was not up to the task, not because the gravitational field frame of reference was static at the location of their laboratory; whereas MGP used arms long enough to detect the difference in $c+v$ and $c-v$ for $v \sim 500$ mph. Thus our MGP interpretation views *light as propagating in the local gravitational field*. If Earth is modeled as a perfect spheroid, its gravitational field translates with the Earth around the sun, but remains fixed rotationally:

> *"If a perfect, homogeneous spheroid spins on its axis; gravitational field does not spin with it… the MGP loop on the surface of the earth rotates through the fixed gravitational field of the earth."*

TK: So our assumption that the local gravitational field is *locally static* because it points toward the center of the Earth *fails* if the field is static only with respect to the center of the Earth and the surface of the Earth moves with latitude-dependent velocity through the non-rotating gravitational field.



Monty: MGP realized that a *round-the-world-Sagnac loop* can be shrunk to a small loop and analogous results obtained – such a loop always involves light from a common source flowing in both directions around the loop, to be recombined near the source. The existence of fringe shift, if any, is a measure of the path differential experienced by light flowing in different directions. The MGP loop is a rectangular pipe with sides approximately a kilometer long oriented such that all sides are on north-south or east-west lines as shown. The northern leg of the loop is at higher latitude and so moves more slowly with velocity $\vec{v}$. The southern base of the loop then moves faster with velocity $\vec{v}+\Delta\vec{v}$. Mirrors at the corners of the

rectangle reflect light at 90 degrees. *The difference in time required for the two [beams of light] to return to the starting point will be*

$$T = \frac{2l_2 v_2}{c^2 - v_2^2} - \frac{2l_1 v_1}{c^2 - v_1^2}$$

where l_1 is the length of the path at latitude ϕ_1, and l_2 at latitude ϕ_2 such that $\Delta\phi = \phi_2 - \phi_1$ with $v_1 = v$ and $v_2 = v + \Delta v$ the corresponding linear velocities of the earth rotation and c the speed of light.

TK: *The only way to make sense of some key relativity experiments is via the gravitational field*, which establishes the true physical frame in which light speed is constant. Gravity provides a local measure of absolute, as in *absolute velocity* of light.

Monty: Yes, clearly MGP established that the Earth's gravitational field translated in orbit about the sun, *but did not rotate with the Earth*; thus Earth *moves through* the gravitational field with latitude-dependent velocity: light travels east-to-west with speed $c + v$ and west-to-east at $c - v$ whereas we interpreted the MM-experiment as being conducted in a laboratory with zero relative velocity to the static ether so the null result was expected, as $c \pm v \equiv c$, where $\vec{v}$ is the velocity of the ether flow.

TK: However, as Correa and Correa [53] point out: Einstein's *ether* is pure metaphysical fiction – *"a pure geometric form set in an imaginary four-dimensional space-time …the 4D topological model of the supposed gravitational ether, devoid of physical properties and divorced from any energetic conception…"* succeeded in the minds of physicists and came to be accepted because it was

> *"metaphysically endowed with mechanical properties, courtesy of the dictatorship of the absolute speed of light."*

I.e., Einstein attached *the physical speed of light to geometric form*, falsely implying physical reality of the geometry. The Correas note that it is at this point that "*relativity ceased being a scientific theory…"* The essential religious nature of relativity is clear when the head of the *Physics Department at Stanford* claims that it cannot be understood by humans because

> *Our minds did not evolve to understand the very fast [or the very small]*.

If such is the case then all attempts to understand physical reality are doomed to failure and the mystery and its formalisms can only be transmitted by the trained priesthood. Thus [53] *"the current imperium of relativistic truth has been selected by social and political criteria that are entirely foreign to science itself."*

A major consequence of MGP

TK: I am grateful that Monty found MGP and realized its significance for *gravity-as-ether*. In 2006 I "re-discovered" gravitomagnetism, without realizing that Maxwell and Heaviside beat me by ~ 150 years. Yet I differed from their pure analogy with electromagnetism (see p.20, eqn (1)) and I concluded, based on physical intuition [56], that $\vec{\nabla} \times \vec{G} = 0$ instead of the analogous $\vec{\nabla} \times \vec{G} = -\partial \vec{C} / \partial t$, while in 2009, based on a mathematical self-interaction formalism [57] I showed that $\vec{\nabla} \times \vec{G} = 0$. In the mean time I have not pushed this interpretation because I was not sure how to prove it, but the *Michelson-Gale-Pearson experiment* clearly shows that the gravitational field $\vec{G}$ does *not* rotate physically and thus establishes $\vec{\nabla} \times \vec{G} = 0$.

Two interpretations of the world: Space-time symmetry & energy-time conjugation

After seeing his guests off for the night, the Tavern Keeper reviewed the evening.

On one hand, ***space-time symmetry*** offered the concept of multiple worlds, each with its own space and time dimension and physical laws of inertia and a constant speed of light. The basic objects are 4D-inertial reference frames, each possessing a local space and a unique time dimension, and Lorentz groups $(x', y', z', t') = L(x, y, z, t)$ transform between worlds. Lorentz's laws of velocity addition replace classical velocity addition, and no framework is preferred over another. Gravity and rotation are excluded from special relativity. Twins age differently during trips; my clock runs slower than yours while yours runs slower than mine; a 40' pole fits in a 20' barn; and *non-inertial massless perfect clocks* tell the time attached to the moving object. *Multiple time dimensions* were designed-in, *demolishing the intuitive notion of time as universal simultaneity*, and replacing it with built-in non-intuitive *relativity of simultaneity* and accompanying self-contradictions. Physics became non-intuitive.

"Our minds did not evolve to understand space-time symmetry."

On the other hand, an ***energy-time conjugation*** reinterpretation of the facts appears to support a universe of absolute space and time, with space abstracted from the gravitational field and time measured by inertia-dependent oscillator counts. Local gravity defines the preferred frame for constant light speed. The energy factor $\gamma(v^2/c^2) = (1 - v^2/c^2)^{-1/2}$ applies to *inertial mass*, not *relative velocity*, and is explainable by gravito-magnetic energy storage. Based on $m = \gamma m_0$ $\vec{p} = m\vec{v}$, $E = mc^2$ in a universe with *absolute space filled with a gravitational field*, a real physical world of energy-flows replaces imagined Lorentz transformations on 4D geometries. *Absolute time is experienced by human consciousness*, while actual inertial clocks, having mass, measure local oscillations of known frequency, and use this to 'tell time'.

Indeed our minds did evolve to understand energy-time conjugation.

We have examined two major classes of experiments that address special relativity:

- Time dilation *space-time symmetry* vs. *energy-time conjugation*
- Light-in-ether *ether dragging* vs. *gravity-as-ether*

While the *light-in-ether* experiments are actually the most interesting physics – including gravity and rotation – it is *'time-dilation'* that makes believers out of most special relativists. Although many believe in Lorentz *length contraction*, there is no experimental support for such and velocity addition is contra-indicated. Special relativity is typically sold as a *take-it-or-leave-it*-package of *space-time symmetry*, *relativity of simultaneity* based on *multiple time dimensions*, with **time dilation** measured by *perfect inertia-less clocks*. It is highly unlikely that physicists would buy all of the non-intuitive nonsense of relativity without the multiple *proofs* of time dilation. Thus the key significance of *energy-time theory* is its acceptable explanation and reinterpretation of time dilation. *Energy-time theory*, based on relativistic mass $m = \gamma m_0$ and Galilean translation, posits inertial clocks that resonate with an inertia-based restoring force, hence when *inertia increases* the clock counting rate goes down – *moving clocks run slower*.

The most fascinating light loop experiment is the Michelson-Gale-Pearson Sagnac latitude-dependent loop which requires the *gravity-as-ether interpretation* to make sense, i.e., to explain the physics. The MGP experiment brilliantly employed a properly scaled *Sagnac loop* to measure the rotation of the Earth via differential latitude-dependent velocities. Special relativity ignores **gravity** and **rotation**, which is to say gravito-magnetism. Willful ignorance of *gravity and rotation* allows relativists to accept unphysical nonsense as gospel. Question: after a brief review of energy-time features what missing space-time symmetry features would you like back?

Reconcile:

- *The gravity-as-ether concept explains the MGP data.*
- *"Einstein's axioms logically eliminate the ether concept in physics."*

Once a universal medium, the ether, through which electromagnetic waves propagate, was lost, there was *no substantial basis* for a constant speed of light. Einstein filled this loss with his *axiom* attaching the speed of light to every moving object. This nonsensical, non-sensible requirement generates *paradoxes;* which is 'nice-speak' for *logical contradictions in the middle of the theory*. Recovery of the ether concept contradicts Einstein's axioms by establishing a preferred frame in which the speed of light is constant.

Accepting the premise

TK: When one considers special relativistic paradoxes and non-intuitive nonsense, it begs the question:

> *How could three generations of brilliant physicists believe that relativity was a correct theory*?

Logical positivism confused many, while Planck's quantization and associated physics seemed to threaten all classical physics. Einstein's gedanken experiments were accepted because actual measurements were impossible; those that were possible, like Fizeau, were misinterpreted. Einstein's general theory of relativity, based on *curved space-time*, further narrowed the group of those who could confidently challenge special relativity. Eventually, the *muon* was interpreted as <u>proof</u> of time dilation and increasing evidence of the validity of $E = \gamma mc^2$ led to acceptance of space-time symmetry with all its paradoxical implications. Nevertheless, there is one key reason that special relativity still haunts us:

> *The game of logic is played in such a way that, <u>if one accepts the premises</u>, and strictly follows formal rules of logic, then <u>one is obliged to accept the outcome of the argument</u>, or be ostracized as an illogical fellow. This has sustained Einstein's Special Relativity for over a century. The false premise, by which <u>Einstein sneaks his fundamental error into every argument</u>, is defining each inertial reference frame as having its own universal time, followed by defining all problems as involving multiple such inertial reference frames. If one does not rebel at the false premise, <u>built into the definition of the problem</u>, then there is no other logical escape from the game.*

If one **accepts the proposition** that Lorentz is required to relate *two* frames, *then* formally logical conclusions are accepted as a matter of faith. Fortunately, once one **accepts the proposition** that electromagnetic waves propagate in the gravitational field, one can begin to make sense of physics.

There are many challenges to Einstein's special relativity, but almost all of them accept *Minkowski space-time* and accept *multiple time dimensions***.** Most also accept *Lorentz velocity-based transformations* and *length-contraction* and *time-dilation*. Some books [58] review such approaches, exemplified by:

> Duffy: *"the modern ether can be treated as a sea of information, and a generator of dynamic algebras, which is revealed as a discretum rather than a continuum on the smallest scales of space-time."*

> Cahill [2006] regards '*space-time concepts as unhelpful*' and believes *space is a quantum system, "an ongoing restructuring of the quantum foam [which] arises in an information-theoretic formulation of relativity."*

These alternate conceptions of physics *do not attempt to identify the false premises underlying physics*; instead focusing on *special relativity* and assuming other fields of physics are flawless. But it will not do to 'patch up' physics here and there; not removing nonsense from physics, but shifting mystery from an area on which we're focused to another area that we do not challenge. It is generally correct to reject these helpful but partial insights. We must remove <u>all</u> false premises to attempt a new synthesis of physics.

Summary

The *take-it-or-leave-it* package of special relativity based on Einstein's symmetry [no preferred frame] leads to non-intuitive nonsense (contradictions) that has bothered physicists for over a century. The key reason very intelligent physicists have accepted special relativity is the existence of multiple "proofs" of time dilation – ranging from 'the muon' to the Hafele-Keating time differences. Relativists have only *space-time symmetry* to interpret these "proofs", so they tend to buy the package.

We offer an alternative interpretation – we replace space-time symmetry with energy-time conjugation. The key issue of "time dilation" is still present, but it is re-interpreted as based on inertial clocks instead of Einstein's imagined massless 'perfect' clocks. All the logical contradictions of special relativity vanish in the *energy-time theory* and physics makes intuitive sense again.

Key features of energy-time theory:

- Time is *absolute and universal*.
- *Space-time symmetry* (no preferred frame) is nonsense based on geometry, not physics.
- *Energy-time conjugation* is a physical interpretation replacing *space-time symmetry*.
- The physical gravitational field is *the local ether* through which waves propagate.
- Velocities do not Lorentz transform (*addition law*); they only Galilean transform.
- *Inertial clocks measure local energy* by counting characteristic cycles.
- Clocks do not directly measure 'time'; there is no native 'time transducer'.
- The Maxwell-Hertz equations are Galilean invariant.
- Apparent length contraction is a Doppler phenomenon.
- Lorentz *length contraction* does not exist.
- The *energy factor* γ is properly applied to mass (not velocity).
- Local energy does *not* affect universal time.
- Local energy affects characteristic frequencies, hence *apparent time dilation* of clocks.
- 'Empty space' does not exist; it is an abstraction from a field, it is not physical.
- Gravitational change to local energy affects characteristic frequency, hence 'time dilation'.
- An axis of rotation establishes an 'absolute' local space, i.e., a preferred inertial frame.
- Gravity does not affect lengths (other than mechanical 'compression').
- The 'curved space-time' metric substitutes for gravitational field energy in flat space.
- Gravitational energy affects mass [Stan Robertson's paper on exponential metric].

Since *a temperature-insensitive clock cannot be built*, all clocks, to some degree, measure energy. To conceive of *massless* clocks measuring time is one fantasy too many, and drawing major conclusions about the *nature of time* and the *nature of intuition* based on such fantasy is unacceptable.

We have identified the way in which Einstein embeds a false premise in his special theory of relativity. Unfortunately, identifying Einstein's false premise does not bring a unified theory into being. There is still confusion and contradiction between general relativity and quantum theory. The contradictions of course point to the existence of false premises built into general relativity and quantum theory. It is our goal to uncover and expose these false premises in following papers, and thus bring physics into a *unified theory* versus our current *aggregate theories of physics.*

Acknowledgments

No theory reaches the public without the cooperation of key individuals who invested enough time to criticize and enough patience to play the game. The hard wall I initially bounced any theory against was Dick Zacher. Next hardest was Steven Kenneth Kauffmann, from whom I gained innumerable insights. Steven not only criticized my theories, but offered alternate approaches.

It has been a pleasure to work with Stan Robertson on gravito-magnetic issues. My quantum-field-theorist-patent-attorney, Tony Diepenbrock, has argued key relativity points with me. Longtime friend Jonathan Wilcox has improved my absolute velocity measurement device by suggesting *slow-light*.

My Intel alumni friends have also been supportive. Mark Olson discussed the $\vec{\nabla}\times\vec{G}$ question with me over a decade ago, while Ted Hoff built and tested a silver-atom furnace for a Stern-Gerlach extension.

Many *FQXi* friends have made valuable, helpful conceptual contributions on annual topics. *FQXi'ers* are like *Qanons* – with near cult-like devotion to an all-absorbing information channel; with new info beating against old info such that dedicated investigators of various backgrounds can absorb themes and obtain insights, some of which are quite helpful. Daryl Janzen contributed ideas on absoluteness in relativity.

Monty Frost has labored in the trenches, many of which he dug and located in front of us. Almost every aspect of my Stern-Gerlach theory has been discussed and argued with Monty – similarly every aspect of *energy-time conservation* vs the *space-time symmetry preservation* interpretation of relativity. Monty is certainly the record-holder for hours invested in my theory. Monty immediately recognized the implications of MGP, making, as always, every effort to ensure that he understood my theory. His realization that my static *gravity-as-ether* (as explanation for the MM-experiment) was challenged by the MGP experiment is a major contribution.

I thank all of you who have invested time and effort in understanding my theory, for arguing to make sure that the theory better reflected your understanding. And thanks to those who still don't buy it. Special thanks to my wife Karen, my editor who insists that everything make sense to her before approval.

I do believe that anyone who goes down the trail of the new *energy-time understanding of relativity* will abandon the established Einstein special relativity – with its paradoxes and unphysical abstractions.

Edwin Eugene Klingman, 24 Dec 2018

References

1. H Hertz, 1890, *Electric Waves,"On the fundamental equations of electromagnetics for bodies in motion",* (Dover)
2. A Einstein, 1905, '*On the electrodynamics of moving bodies'*
3. O Heaviside, 1893, *'A gravitational and electromagnetic analogy'*, *The Electrician.*31:81-82
4. E Klingman, 2016, '*The Nature of Quantum Gravity*', *viXra:1702.0117*
5. O Jefimenko, 2006, *Gravitation and Co-gravitation*, (Electret Scientific Co.)
6. B Abbott et al. 2017, '*Observation of Gravitational Waves from a Binary Neutron Star Inspiral*' *PRL 119, 161101*,
7. W Rindler, 1991, *Introduction to Special Relativity*, 2nd Ed. (Oxford Science Pub, Oxford)
8. T Maudlin, 2012, *Philosophy of Physics: Space and Time* (Princeton U, New Jersey) (p.157)
9. T Phipps, 2012, *Old Physics for New, 2nd ed*., Apeiron Press,
10. C Renshaw, 1998, *'A Direct Test of the Lorentz Length Contraction'*, *IEEE AES Magazine*
11. A Einstein, 1961, *Relativity: The Special and the General Theory* (Crown Publishers, New York)
12. E Klingman, 2017, '*An energy-based derivation of Lorentz transformation in one inertial frame*', *viXra:1712.0530*
13. *A Bennett and Gibble, 2017,* '*Atomic Clock Measurements…*', *Phys Rev Lett* 119, 113401 15 Sep 2017
14. T Faber, 1995, *Fluid Dynamics for Physicists,* (Cambridge)
15. L Kostro, 2000, *Einstein and the Ether*, (Apeiron)
16. A French, 1968, *Special Relativity*, (WW Norton, New York)
17. W Dixon, 1978, *Special Relativity* (Cambridge U Press, Cambridge)
18. J Freund, 2008, *Special Relativity for Beginners* (World Scientific, New Jersey)
19. L Susskind, 2017, *Special Relativity and Classical Field Theory*, (Basic Books)
20. R Cahill, 2008, '*Unravelling Lorentz Covariance and the Spacetime Formalism*', *arXiv:0807.1767*
21. G Volovik, 2009, *The Universe in a Helium Droplet*, Oxford Science Pub.
22. N Flowers et al., 2017 *'…Gravimeter Tests of Local Lorentz Invariance',* PRL 119, 201101 (17 Nov 2017)
23. A Bourgoin et al., 2017, *'Lorentz Symmetry Violations… '*, PRL 119, 201102 (17 Nov 2017)
24. Reference, 2017, to Hertz's 1890 version equations reproduced in *Endnotes*.
25. J Wesley, 1991, *Selected topics in advanced fundamental physics*, (Benjamin-Wesley Pub.)
26. Gasbarri, Toros and Bassi , 2017, *General Galilei Covariant Gaussian Maps* , PRL 119, 100403 (8 Sept 2017)
27. W Panofsky and M Phillips, 1962, *Classical Electricity and Magnetism* (Addison-Wesley, Reading, MA)
28. J Jackson, 1962, *Classical Electrodynamics* (Wiley, New York)
29. P Lorrain and D Corson, 1988, *Electromagnetic Fields and Waves* (Freeman, New York)
30. R Wangness, 1979, *Electromagnetic Fields* (Wiley, New York)
31. H Ohanian, 1988, *Classical Electrodynamics* (Allyn & Bacon, Boston)
32. W Smythe, 1950, *Static and Dynamic Electricity* (McGraw-Hill, New York)
33. E Purcell, 2004, *Electricity and Magnetism* (McGraw-Hill, Boston)
34. Lucas and Hodgson, 1990, *Space-time and Electromagnetics*, (Oxford)
35. A Mears, et al., 2013, *African Review of Physics*, (2013) 8:0043
36. M Cannoni, 2016, *Lorentz invariant relative velocity…* , arXiv:1605.00569v2
37. D Neuenschwander, 2011, *Emmy Noether's Wonderful Theorem*, Johns Hopkins Press
38. V Fock, 1964, *The theory of space, time, and gravitation, (2nd Ed.)*, (Permagon, Oxford)
39. S Weinberg, 1995, *The Quantum Theory of Fields, Vol. I*, (Cambridge U., Cambridge)
40. K Thorne and R Blandford, 2017, *Modern Classical Physics*, pub?
41. https://news.harvard.edu/gazette/story/1999/02/physicists-slow-speed-of-light/
42. https://www.photonics.com/d6486/quantum
43. LaHaye, et al., 2012, *Am J of Physics 80, 497*
44. J Duboisset and Brevet, 2018, *Phys Rev Lett* ***120****, 263001* (27 June 2018)
45. C Weidner and Anderson, 2018, *Phys Rev Lett,* ***120****, 263201* (27 June 2018)
46. R Ohta, et al., 2018, *Phys Rev Lett* ***120****, 267401* (26 June 2018)
47. C Will, 2018, *Phys Rev Lett* ***120***, 191101 (8 May 2018) '*New - Contribution to Mercury's Perihelion Advance'*
48. K Hartnett, *Quanta Magazine, 'A proof about where symmetries cannot exist'*

49. R Pound and V Rebka, 1959, '*Gravitational Redshift*…', *Phys Rev Lett, 3, 439*
50. R Cahill, 2015, *Progress in Physics* vol. 11, p.15
51. J Bell, 1987, *Speakable and Unspeakable in Quantum Mechanics,* Cambridge, p.77
52. T Hafele and R. Keating, 1972, *Science* vol 177, 4044 (July 14, 1972) pp.166-168
53. P Correa and A Correa, 2008, '*The Sagnac and Michelson-Gale-Pearson Experiments*'
54. S Hossenfelder, 2018, *Lost in Math, Basic Books, New York, p.95*
55. M Frost email, 2018, *to E. Klingman: Thursday, Nov 01, 2018 @ 2:54 PM–*
56. E Klingman, 2008, *Gene Man's World*, ISBN: 978-097917655-5, p.288
57. E Klingman, 2009, *The Chromodynamics War*, ISBN: 978-097917657-9, p.132 & p.151
58. M Duffy, 2008, *Ether Space-Time & Cosmology*, Vol. 1-3
59. A Huxley, 1932, *Brave New World*